OBSERVATIONS ON ANEURISM,

AND ITS

TREATMENT BY COMPRESSION.

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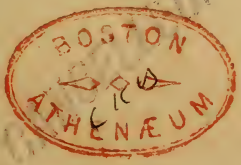

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PREFACE.

The following pages contain a sketch of the history of the treatment of aneurism by compression, from the rude attempts of its earlier advocates to its present improved state; accompanied by an abstract of every case that has been reported, in which compression has been hitherto used—at least of every case which the author has met in a rather extensive reading. The various instruments which have been employed for making pressure are described; and the theories upon which it has at different times been supposed to effect the cure of aneurism are noticed. The author has also endeavoured to point out some of the advantages which compression, as a mode of treating aneurism, possesses over the ligature, when the position of the sac permits of its application; he has added some rules for the guidance of the surgeon in its application: and it has been all through his aim to refer every invention to its proper author, and every improvement, either in the theory or practice of this method of treating aneurism, to its legitimate source.

The theory upon which compression effects the cure of aneurism advocated in these pages, is not laid down *now* for the first time; it was advanced several years since by the author in a paper communicated to the Surgical Society of Ireland, which was printed in the report of their proceedings; he has here, however, been enabled to adduce pathological evidence in proof of its correctness.

The author's views respecting the pathology of aneurism, particularly the exact manner in which the disease is cured, differ from those usually taught; and some proofs have been adduced that the cure of aneurism is accomplished in a similar manner, whether the ligature is employed, or compression is used, or whether the cure has been brought about by Nature's unaided efforts.

Galvano-puncture having been recently re-introduced with the object of endeavouring to effect a rapid cure of aneurism, and some cases in which it is stated to have been used with success having been reported, the author has thought it necessary to devote a distinct chapter to it.

In conclusion, the author has to apologise for the controversy into which he has been led, in some parts of the present work, owing to the publication in a recent number of the *new series* of the *Dublin Journal of Medicine*, of an article purporting to contain an impartial history of compression in aneurism, from the pen of the editor of that journal; but in which almost every matter connected with this method of treating aneurism is misrepresented, and every fact connected with its recent history is distorted. The author would have consulted his own inclination more, and the taste of his readers better, perhaps, if all notice of the article alluded to had been omitted, particularly as the *new series* of the *Dublin Journal of Medicine* being bookseller's property, and its editor the *mere nominee* of a bookseller, his statements can carry with them no greater weight than such a position confers.

Eccles-street, Dublin, January 21, 1847.

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ON COMPRESSION IN ANEURISM.

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The success which has attended the employment of compression in aneurism within the last few years, when contrasted with the results of earlier attempts, has been so marked, that it might be a matter of some interest to inquire into the causes of its failure, and abandonment formerly; as well as to examine the principles upon which this mode of treatment should be conducted, in order to ensure success. Such an inquiry would render it necessary to trace back the history of compression in aneurism from its earliest employment, and to follow its progress down to the present day. I have ventured to undertake this task, partly because I have already taken some share in the discussion of this subject, and have had some experience in this mode of treating aneurism; and partly, because I should regret for the credit of Irish

surgery that such a *burlesque* of this history, as is contained in a late number of the *Dublin Quarterly Journal of Medicine* (from the pen of the editor of that journal) should go abroad uncommented on; and be supposed either to contain a faithful record of the principal facts of the history of the cure of popliteal aneurism by compression; or to represent the views of those who are at all conversant with the literature of the subject.

The early history of the treatment of aneurism by compression is intimately mixed up and associated with that of the treatment of wounds of arteries: and it would be difficult to trace the remote history of the one proceeding without entering into some details respecting the other. The terms pressure or compression, likewise, have been applied to proceedings which differ materially from one another, both in the agents used, and in the manner in which they were employed; though all agreeing in one point, that pressure was somewhere or somehow applied. Thus, sometimes the pressure was applied to the aneurismal sac, or to the aneurismal sac, and the artery leading to it; and where this was impossible from the situation of the aneurism, to the capillary side of the tumour, or the entire limb was at the same time compressed. The pressure, in some cases, was effected by compresses and tight bandages; in others, the compresses were soaked in styptics, and plasters of various kinds were applied; or the compression was maintained by the use of instruments or apparatuses of various forms and construction.

The several methods which come under this name, or which have been at different periods recommended or employed, may, however, be comprised under the following heads:—

1. Where the pressure was applied directly upon the aneurismal sac.

2. Where the pressure was applied to the aneurismal sac, and the entire limb was at the same time compressed.

3. Where the compression was applied to the artery between the aneurismal sac and the heart.

4. Where the pressure was applied to both the aneurismal sac and the artery upon the cardiac side.

5. Where the pressure was applied to the distal or capillary side of the aneurismal sac.

6. Where the aneurismal sac was laid open, and the pressure was applied upon the ruptured or wounded vessel.

7. Where the artery above the aneurism was laid bare, and the pressure was applied directly upon it.

On its first employment, compression was always applied immediately upon the aneurismal sac, and the practice would seem to have had its origin in the use of compresses, bandages, and similar appliances, in cases of accidental wounds of arteries; for even among uneducated persons, the first efforts are almost instinctively directed to stop bleeding; and bandages and compresses have always constituted the earliest applications after such injuries. Wounds of arteries in former times were sufficiently frequent to afford surgeons the opportunity of learning the effects of pressure upon them, and as such accidents must have been occasionally followed by aneurism at the part, for trying the effects of compression upon it. But a long period seems to have elapsed before they ventured to adopt so simple and obvious a method; partly owing to the erroneous views they had of the nature of aneurism; and partly to their ignorance of anatomy, especially of that of the arterial system.

The first, in fact the only form of aneurism in which compression was originally employed, was traumatic aneurism; particularly that caused by the accidental wound of the brachial artery in venesection. This accident, in

former times, appears to have been sufficiently frequent, so much so that in the time of Dionis, surgeons were by law in France compelled to pension those whose arms they had injured in bleeding. Indeed down to a comparatively advanced period, most of the cases of traumatic aneurism which surgeons were called upon to treat had a similar origin, owing to the frequent performance of this operation by ignorant and uneducated persons. John Bell, in his Principles of Surgery, alluding to this circumstance, observes—"Our legislature does not prevent the most ignorant from meddling with a profession which should be sacred as the priesthood. Masons, butchers, gardeners, cowherds! are among the chief phlebotomists in this country; and it is to them we are indebted for the various specimens of aneurism."

In wounds of the brachial artery in venesection, compresses, bandages, styptics, plasters, &c., constituted always the first applications, and the older writers have left us copious directions how to apply them; and many cautions against being over hasty in removing them. Now as wounds of the brachial artery were sometimes undoubtedly cured by these applications, it is only reasonable to suppose that they were tried, and occasionally succeeded after the formation of an aneurism; although, until the 17th century, no well authenticated case of the kind is upon record.

Medical historians are not agreed as to the exact period at which compression came first to be used as a mode of treatment in aneurism; or as to the exact person to whom the credit of first suggesting this improvement belongs.

Sprengle, in his History of Medicine, asserts that Jean de Vigo, a physician of Genoa, who lived in the beginning of the 16th century, was the first to conceive the idea of curing an aneurism by pressure. He used compresses of charpie wet with styptic solutions, which were applied to

the aneurismal tumour, and maintained by bandages rolled tightly round the limb. On the other hand, M. Dezeimeris, in his History of the treatment of Aneurism, appended to the second edition of the Dictionnaire de Médecine, asserts that the Abbé Bourdelot, who wrote in the year 1681, was the first to effect the cure of an aneurism by compression.

I have been unable to find the case referred to by Sprengle, (not having had the opportunity of meeting with any work by De Vigo,) but he might evidently have gone much further back, for Galen is said to have cured an aneurism at the bend of the arm by means of sponge and bandages; and Rhazes likewise is stated to have recommended similar measures. M. Dezeimeris is, however, certainly incorrect in his assertion, because, although the Abbé Bourdelot's case is the best known, it is not the first well authenticated case upon record of the cure of an aneurism by compression. Tulpius, a physician of Amsterdam, who wrote in the year 1641, has recorded a case where an aneurism, the result of a punctured wound, arose between the thumb and forefinger. He applied "an astringent plaster, and sustained it on the part by a thin plate of lead and a bandage; and within the space of four months the aneurism totally vanished;" Pilas likewise has shortly reported a second case in the second volume of the Miscell. Acad. Nat. Curios. for the year 1671. The patient was sixty years of age, the aneurism was seated at the bend of the arm, is stated to have been *satis magnum*, and the patient was cured in three weeks.

Genga, an Italian surgeon, in the year 1673, successfully treated a third case of brachial aneurism by compresses, and a form of bandage which afterwards went by his name. The case is quoted at length in Scarpa's work on Aneurism.

The Abbé Bourdelot is, however, entitled to the credit of having first invented and applied a compressing instru-

ment for the cure of aneurism. He had the misfortune to have the brachial artery of his right arm wounded in venesection, and he has detailed his case, and given a description of the instrument, (by the long-continued use of which he was eventually cured) in *Blegny's Zod. Med. Gallic*, published in the year 1681. This instrument, named a *Ponton*, appears to have been a very simple contrivance; it consisted merely of a pad of a peculiar shape, with leathern straps attached, which passed round the arm, above and below the elbow, and were perforated with holes to permit of their being tightened or loosened. The pad had a hollow or channel on its under surface, which it was supposed would permit the blood to pass freely down the artery under it, as a bridge (ponton) permits the water to flow under it (hence the name.) A rude figure of Bourdelot's instrument is contained in Dionis' Cour d'Operations, 5th edition, published at Paris in 1757.

The following is a condensed account of Bourdelot's case given by himself:—"I had the artery at the bend of my right arm punctured where it passes under the median vein. On seeing the blood flow per saltem, I applied graduated compresses, and kept the arm quiet for some time; the skin soon healed, and an external cicatrix was quickly formed. In no long time afterwards a small tumour made its appearance, which gradually increased without my being able to arrest its growth; and it subsequently attained the size of a hen's egg." He accomplished a cure by wearing for a year the instrument described above; the pad left a hollow at the bend of the arm, which was filled up in the course of three or four months; there remained not the smallest mark of the tumour, but for two years subsequently he was sensible of a degree of constriction in the situation of the wound, which, however, eventually entirely disappeared.

In the same journal for the year 1681, Rogerus has

related a similar case; the aneurism was, however, of a smaller size, and of more recent date. The case has been quoted by Mr. Erichsen in his late work on Aneurism, edited by the Sydenham Society. A girl, 13 or 14 years old, was brought to him in the year 1665, in consequence of the artery at the bend of the arm having been punctured in bleeding twelve or fifteen days previously. "On examination I found a pulsating tumour about the size of a hazlenut. I applied a compress a number of times doubled in which I had placed a piece of tin about the size of a fifteen sous-piece, above this another compress, but somewhat larger, lastly a third, still larger. I then used the form of bandage generally applied after venesection, but tied it so tightly that on the following day the whole arm was swollen, when I loosened it somewhat, pressing the compresses firmly with my fingers: I then contented myself for eighteen or twenty days with keeping down inflammation. At the expiration of this period I undid the bandage and removed the compresses, and no longer finding a tumour, but on the contrary a depression in the skin, I applied a bandage lightly, and sent the girl home."

In the Miscell. Acad. Nat. Curios. for the year 1688, Rommelius has related at some length another nearly similar case, where an aneurism, the size of a pigeon's egg, formed at the bend of the arm, in a man, aged 23, who had been recently bled. He was perfectly cured in the course of three months, by plasters, bandages, and compresses, containing a plate of lead.

The *ponton* of Bourdelot was not the only apparatus for applying compression employed at this period. Scultetus, in his Armamentarium Chirurgicum, published towards the end of the 17th century, has figured another form of instrument which long went by his name, and which appears to have had several advantages over the *ponton;* for while the latter acted in some measure by compressing

the entire limb, the former compressed only the artery. Scultetus's apparatus consisted of two flat metal hoops or rings, into which the arm readily fitted, they were joined by connecting flat pieces, into one of which a screw with a pad at its extremity was fixed; the instrument was sufficiently long to reach from the elbow to the wrist, and pressure was effected by turning the screw. Scultetus invented it for wounds of the palmar arch, but it came afterwards to be used in wounds or aneurism of the brachial artery.

From the introduction of compression as a mode of cure in aneurism down to the end of the 17th century, pressure was limited to traumatic aneurism, and was employed only in cases where the tumour was small, the aneurism recent, its contents fluid, the skin uninflamed, and the disease seated in the brachial artery or some of its branches. The pressure was always applied directly upon the aneurismal sac, and the arm was generally also firmly bandaged; styptics and plasters were very generally used at the same time, the arm was confined to the side, and the patient was kept upon a cooling regimen, and occasionally bled. The theory, at the period in question, of the mode in which compression effected the cure of aneurism was, however, anything but correct. The pressure of the pad or compress was supposed not only to prevent the further dilatation of the artery, but to press the blood contained in the sac back again into the vessels, just as a fluid is squeezed out of a sponge. In addition, they supposed that under the action of the pressure the edges of the wounded artery were brought into apposition, and adhesion took place between them, so that the channel of the artery was preserved, and on the discontinuance of the compression the blood passed down the artery as before the injury. The surgeons of that period were confirmed in these erroneous views, by finding that the pulse in the radial artery, which was imperceptible when the aneurism

was first compressed, became subsequently nearly as strong as in the opposite arm.

The commencement of the 18th century was distinguished by the invention of the tourniquet; by which operations upon the arteries were much facilitated. At this period also the practice of applying pressure in cases of recent aneurism at the bend of the arm seems to have become general; but down to the middle of this century, improvements in this mode of treating aneurism seem to have been in a great measure limited to alterations or modifications of the apparatuses of Bourdelot and Scultetus, or to the invention of new forms of compressing instruments.

Among the instruments invented or improved at this period, those of Vallant, Senffio, Arnaud, Heister, and Foubert, are the most deserving of mention. Vallant's instrument, which is said to have been an improvement upon that of Scultetus, is described by Haller in the fifth volume of his Disputationes Chirurgiæ, published in 1750. It consisted of a hoop or circle of iron, or silver, of larger diameter than the arm; that part into which the elbow fitted was perforated for a screw, which terminated in a pad; the pressure was effected by turning the screw, which could thus be applied upon any single point. The principle of this instrument is precisely the same as that of Scultetus, and it is in fact the instrument of the latter adapted to the elbow-joint.

Senffio's instrument, which is a great improvement upon the *ponton* of Bourdelot, consists of a metal central plate, with four arms or branches, the plate is perforated by a tourniquet screw which ends in a pad; the arms of the instrument are curved so as to reach half round the arm, and each terminates in a hook; it is secured on the arm by two straps perforated with holes, which are attached to the hooks, and the compression is effected by turning the screw. Figures of this instrument and of the

mode of applying it are given in Plattner's Institutiones Chirurgiæ, published at Leipsic in the year 1758. Freer, in his Observations on Aneurism, also gives a figure of it, and recommends it as well adapted for the purpose. Arnaud's instrument is figured by Ernest Plattner in the supplement to his father's work, but appears to have nothing to recommend it beyond novelty.

Two compressing instruments are figured and described in Heister's Surgery, which resemble each other in almost every particular except size. The figures and descriptions have been copied into James' Medical Dictionary, published in London in the year 1743. They differ materially from the instruments of Scultetus, Bourdelot, Senffio, and Arnaud. Heister does not mention the name of the inventor, but says that they were generally employed, at the period he wrote, in cases of aneurism at the bend of the arm. In appearance they resemble hernia trusses, the broad extremity has, however, a metal plate underneath, and is connected by a hinge to the outer; the latter is perforated by a screw, which acts upon the under plate to which the pad is attached, and the compression is effected by turning the screw; the narrow extremity terminates in straps provided with holes by which it is secured upon the part. These compressors closely resemble the instrument figured by the late Mr. Todd in the third volume of the Dublin Hospital Reports.

Foubert's instrument is described in the second volume of the Mémoires de l'Académie Royale de Chirurgie, published at Paris in the year 1753. It consisted of an iron hoop somewhat oval in shape, having at one side a plate and pad, the opposite side was perforated for a screw, which had at its extremity another pad of larger or smaller size, according to the size of the wound and the volume of the part to be compressed. It was intended to unite the advantages of Scultetus's compressor and the ponton of

Bourdelot. This instrument, Foubert states, he had constructed of different sizes, so that it could be adapted to the thigh and leg as well as to the arm.

In addition to compressing instruments, a form of bandage, invented by Genga, was in pretty general use at the period in question, and seems to have been sometimes preferred in wounds of the brachial artery. The following is Guattani's description of the mode of applying this bandage. The axillary artery and the wounded vessel being compressed by an assistant, and a tourniquet tightened above the elbow, each finger of the hand on the affected side is to be separately bandaged, a longer and a broader roller is then to be carried round the hand and forearm, up to the elbow: pledgets, dipped in spirits of wine, or wine and water, are laid on the affected part, and the tourniquet being removed, the compresses and bandages are to be continued up to the axilla. Genga, in addition, placed a piece of stick surrounded with lint upon the vessel along the arm, and when the bandage reached the axilla, he carried a second roller from above downwards over the former. The whole was wet twice a day, and the apparatus was not disturbed for twelve or thirteen days.

These compressing instruments and bandages were employed as well in recent wounds of arteries as after the formation of an aneurism; but down to the middle of the 18th century, this mode of treatment was limited to the brachial artery and its branches, or to small arteries in other situations, and to cases where the aneurism was small and of recent occurrence: when the tumour increased much in size, the operation (called that for aneurism) was performed. This consisted in laying open the sac in its whole length, (having previously applied a tourniquet to the arm) removing the coagula and fluid blood; tying the artery above and below the opening; then filling the wound with charpie; and applying bandages and compresses.

CHAPTER II.

History of compression in aneurism from the middle of the 18th century to the period of the first performance of the Hunterian operation—Heister the first to propose the employment of pressure in popliteal aneurism—Guattani the first to succeed in curing popliteal aneurism by compression—Cases reported by Guattani—Compressing instrument of Vicq d'Azyr—Erroneous theory upon which pressure was used at this period—Injurious consequences likely to follow the application of pressure to the aneurismal sac—Mode of applying pressure termed immediate; described by Sabatier—Theory upon which it was supposed to effect the cure of aneurism.

The employment of compression in aneurism down to the middle of the 18th century was, as we have seen, limited to traumatic aneurism at the bend of the arm, or to small vessels in other situations. Heister appears to have been the first to propose the extension of this mode of treatment to popliteal aneurism. "If a true and small aneurism (he observes) arises in the knee, of such a character that the blood can be pressed back into the artery, we may try whether by continuing to apply pressure to it by means of a plate, straps, and bandages for several months, it may not be compressed to such a degree that (as happens in the arm) the coats of the artery may grow together, and contract so that it cannot enlarge again. Or if we cannot accomplish this, and the tumour on the removal of the bandages and compresses always returns, I would recommend, in order to avoid a greater evil and a dangerous operation, that the patient should wear the compressing apparatus for the remainder of his life, as many do with advantage who suffer from hernia."

Although Heister never appears to have put this method into practice, he adopted a mode of treatment in a case where the femoral artery was wounded, which probably helped to pave the way for this improvement. The subject of the case was a shoemaker of Helmstadt, who, while employed at his business, accidentally dropped his knife, and in endeavouring to catch it, by bringing his knees together, punctured the femoral artery. Heister effected a cure by filling the wound with charpie, laying a number of thick compresses over it, placing another compress along the course of the femoral artery, and lastly bandaging the whole limb tightly. In order further to prevent hæmorrhage, an oval metallic plate was applied over the compresses and retained for two months; and when the wound had healed, a leathern belt, with an iron plate attached, was worn by the patient afterwards.

The successful termination of this case had not, however, the effect of convincing surgeons that the femoral artery might be obliterated, and the circulation in the limb still be carried on. Indeed the little advanced state of anatomical knowledge at the period in question may be gathered from the fact that Heister looked upon the profunda femoris as an accidental variety, similar to that sometimes seen in the arm, where the brachial artery divides high up; and he attributed the recovery of this patient and his escape from gangrene to the fortunate presence of a double femoral artery. "The crural or femoral artery (he observes) most commonly descends through the whole thigh quite to the knee in one single trunk, sending out only very trifling branches to the great muscles of the thigh; but nevertheless it does sometimes divide in the upper part of the thigh into two great arteries." He even considered it hazardous to obliterate the brachial artery at the bend of the arm, "the lateral small branches of arteries being incapable of imparting a due

quantity of blood to the hand and parts of the elbow when one of the large branches is wanting."

The first to attempt and to succeed in the attempt to cure popliteal aneurism by compression was Guattani, an Italian surgeon, who flourished about the middle of the last century. He appears to have been induced to try this method, partly from the success which attended the employment of pressure in aneurism at the bend of the arm following venesection; and partly, from his having witnessed a spontaneous cure in three cases of popliteal aneurism; but principally in consequence of the great fatality of aneurism of this vessel, and the lamentable results of every operation for its relief. Popliteal aneurism is a disease (he observes) in which medicine holds out no prospect of cure, in which surgery has almost abandoned all treatment, and in which physicians and surgeons are agreed only in the prognosis.

Guattani's earliest attempts were directed to adapt the operation usually performed in brachial aneurism to the same disease in the popliteal artery, and he has recorded two cases in which he performed it; one was successful, the other not, the patient dying of gangrene. This operation was not, however, new, for according to Testa it had been performed by Keysler in the year 1744. In the next cases which came under his care he amputated the limb above the seat of the disease, but all terminated fatally; two died of hæmorrhage on the night succeeding the operation, and the other two of tetanus within four weeks. Guattani then determined to try the effect of methodical compression and bandages, combined with low diet, perfect rest, and occasional bleeding. The work in which his cases are recorded was published at Rome in the year 1772, and as his method of applying compression is fully illustrated in them, it may be interesting to quote some of the details, particularly as they are the first upon record

in which pressure was successfully used in the treatment of popliteal aneurism.

Case I.—The patient, a porter, aged 40, was admitted into the hospital of the Holy Ghost towards the end of August, 1765, labouring under popliteal aneurism. The tumour was about the size of a large goose egg, was hard and resistant to the touch, had a strong pulsation, and was attended by pain, swelling of the leg and foot, and fever. The patient was directed to remain in bed, was put upon low diet, and bled several times. Towards the end of September the aneurism had ceased to increase, pain was nearly gone, the pulsation had much diminished, and the swelling of the limb had in a great measure subsided.

Guattani was obliged to leave Rome at this period to accompany the Pope on a journey. On his return in November the tumour had not increased, and the œdema of the limb having disappeared, he determined to try the effects of compression. Having first covered the tumour with lint, he laid two oblong compresses over its centre, which crossed one another, and passed round the limb above and below the knee; another compress was laid along the course of the femoral artery up to the groin. He then took a long roller, three fingers' breadth, with which he encircled the knee, commencing above the centre of the tumour, and passing it above and below the joint many times; it was then carried up the thigh to the groin, and for further security he gave it a turn round the body. The whole was moistened with spirits of wine, the patient was bled, and a rigid diet enforced. The bandage was not disturbed for eighteen or twenty days, and then only in order to be tightened; and venesection was repeated whenever the leg or foot swelled.

The tumour, although it remained hard and continued to pulsate, gradually decreased in size, and in three months from the first application of the compression, the patient

left the hospital perfectly well. At this period the tumour scarcely exceeded the size of a bean; and although the patient was obliged to return to his former business, and was frequently obliged to lift heavy weights, he suffered no inconvenience except slight œdema of the leg and foot, which did not prevent him from following his occupation of a porter.

Case II.—The patient, a grave-digger, aged 41, was admitted into hospital in the month of August, 1767, labouring under popliteal aneurism. The tumour was larger than in the former case, but was not so hard to the touch; it was accompanied by severe pain, fever, strong pulsation, and œdema of the leg and foot. The aneurism was of about five months' duration, and had followed a strain.

During the first eight days the patient was bled twice, put upon a rigid diet, and confined to bed, by which the general symptoms were relieved, and the tumour became softer. In a few days more the compresses and bandages were applied as in the last case, and continued until the beginning of November, when the tumour was reduced in size, and the pulsation had ceased. Nevertheless, the compression was continued in a more moderate degree, and the patient left the hospital in the first week of January perfectly well, and suffering no other inconvenience than a slight lameness.

Case III.—This case was treated by Guattani's colleague, Javina. It resembled those last described, and the same mode of treatment was adopted. Within forty days the hardness and pulsation had almost disappeared, and nothing was left but a tumour containing fluid, which gradually and of itself disappeared. The patient at this period was obliged to leave the hospital, but was seen again in a few weeks, during which he had worn the bandages; the aneurism was cured, but some swelling of

the limb remained, which was attributed to the patient having been obliged to move about too soon.

Case IV.—This case was treated by Seghio and Flajani, surgeons at Rome. The patient was a servant, aged 34. Compression was employed as in the foregoing cases, and when the patient was seen by Guattani after three months of this treatment, he was perfectly well; nothing remained but some swelling of the integuments and cellular tissue, probably occasioned by his having been obliged to return to his employment before it was thought right to remove the bandages, &c.

Case V.—The patient, aged 41, was a servant. The aneurism was of sixteen months' duration; for thirteen months the patient had been an inmate of the hospital, part of the time under another surgeon, who contented himself with keeping the patient in bed. He came under Guattani's care in the beginning of May, 1769. The aneurism was seated in the right ham, was of very large size filling the whole popliteal space, extending upwards to the middle of the thigh, and downwards to the calf of the leg. The colour of the skin was natural, the tumour was resistant to the touch, the pulsation very strong in every part, but he complained little of pain.

The patient was bled and put on low diet, compression was then commenced, and the bandages were gradually tightened, venesection was several times repeated, and the tumour began to diminish. After some time Guattani discovered that the patient was in the habit of loosening the bandages in his absence, of drinking wine whenever he could get it, and of committing other irregularities; finally, he was obliged to turn him out of the hospital, ten months after the commencement of the treatment. At this period the tumour was hard and tense, but it must evidently have diminished considerably, for it is described as being then only two inches in length, although its pulsation continued

to be strong. Guattani states that he saw this patient two months subsequently, he seemed in good health and spirits, and on being questioned, said the aneurism was better.

Two cases of popliteal aneurism are then related; in one the patient refused to continue the compression, and died subsequently of gangrene. In the other the aneurism was of very large size, and the limb greatly swollen; compression was employed with some benefit, but being discontinued under the dread of gangrene, the aneurism burst, and the patient died.

Guattani then reports two cases of aneurism low down in the ham. The first is very shortly given, the patient was 24 years of age, compression for a time appeared to be of service, but after a long continuance of it, the patient's strength being broken, the aneurism suppurated, and he died.

The second case is related more at length. The patient was a servant, aged 30, the aneurism was seated in the upper part of the calf of the right leg near the ham; it resembled in size and shape a hen's egg, was hard and resistant, and had a very sensible pulsation. After bleeding, rest, and low diet, compression was applied as in the foregoing cases, but although the pressure was moderate, so much pain was produced that he was obliged to discontinue it, notwithstanding the repetition of bloodletting. After a few days the bandage was reapplied but not tightened; it now, however, occasioned a return not only of the severe pain formerly experienced, but swelling of the whole joint, with very acute spasmodic pain in the sole of the foot, which continued to recur notwithstanding the removal of the bandage. The tumour increased greatly in size, became painful and inflamed; the spasmodic pain in the sole of the foot subsided for a time, but returned with increased severity, and was only relieved by bloodletting. About four months from the period the

compression had been commenced, the patient was seized with double tertian fever (then prevalent), and died some time afterwards.

Guattani had the opportunity of making an examination of the limb, and has given a drawing of the parts. The aneurismal sac, which was very large, was seated in the lower part of the popliteal artery, just above where the vessel divides; the sciatic nerve lay immediately upon it, and had been flattened and compressed by the tumour.

He states that he employed compression in two other similar cases, but in both also without success. In a subsequent part of his work he has detailed several cases of crural and inguinal aneurism. In one case compression by means of a bandage was kept up for three years with the effect of keeping the disease in check, but it ultimately terminated fatally. In another compression was tried but soon had to be given up, and the patient died. In three others the disease was too much advanced to admit of compression, and in one the patient had an aneurism in each groin.

Omitting the cases of crural and inguinal aneurism, in none of which compression was successful, Guattani has reported twenty cases of popliteal aneurism; three of these underwent a spontaneous cure; six were operated on, of which one recovered and five died, and eleven were treated by compression, of which four were perfectly cured and one so much benefited, that it is probable he ultimately recovered; while in six it failed. The statistics of Guattani's cases are, therefore, greatly in favour of compression in popliteal aneurism (as he practised it) over any operation then known: but the results of the treatment by laying open the sac and tying the artery above and below it were even less satisfactory in the hands of others at the period in question, and the danger which attended this operation led surgeons in England to abandon it, and to

recommend amputation of the limb in preference. Thus, Pott, an excellent practical surgeon, writing in the year 1777, observes—"As far as my observation and experience go, the operation for aneurism in the femoral and popliteal arteries, however judiciously performed, will not be successful—that is, will not save the patient's life. I have tried it myself more than once or twice. I have seen it tried by others; but the event has always been fatal: excessive pain, a high degree of symptomatic fever, great tension of the whole limb, rapidly tending to gangrene and ending in mortification, have destroyed all those whom I have seen, on whom the operation of tying the artery has been practised. Nor have I ever seen any other operation than that of amputation which has preserved the life of the patient."

Wilmer also in his "Cases and Remarks in Surgery," published in 1779, observes—"With regard to aneurism of the popliteal artery, there is not that I know, a single case upon record where the operation has succeeded. It has been performed several times within the last few years in our public hospitals, but I have not heard of any one case where it answered the intended purpose."

In the cases treated by Guattani, the chief pressure was always (as we have seen) made immediately upon the aneurismal sac; and the entire limb was at the same time compressed by bandages, rollers, &c. The patient was frequently bled, placed upon low diet, and confined to bed during its employment. In fact, Guattani's method appears to have been only an adaptation of that in general use in brachial aneurism, combined with the medical treatment proposed by Valsalva and Albertini for internal aneurism. His theory, likewise, of the mode in which compression effected a cure, scarcely differed from that of his predecessors; he supposed that the pressure diminished the rapid motion of the blood in the vessel; checked the

further increase of the aneurismal tumour; and caused the gradual resolution of the contents of the sac into serum. Thus, as the tumour subsided, the ruptured artery was healed, and became fit to convey the blood to the leg and foot.

The mode of employing compression in aneurism, which has been now described, was undoubtedly faulty; the process was tedious and painful in the extreme, and the result very uncertain. It was faulty, because the direct pressure upon the aneurismal sac tended to cause its rupture, and the conversion of a circumscribed into a diffused aneurism; or to give rise to inflammation and suppuration in the sac; or to occasion gangrene of the limb. That direct pressure upon a large aneurism is very likely to be followed by inflammation and suppuration of the sac, we have sufficient evidence; it occurred in several of Guattani's cases; but it was a result not much dreaded at that period, because surgeons were aware that if the patient had stamina to hold up under the tedious suppuration which necessarily followed, the aneurism was sure to be cured; and the chances of recovery were rather greater than after operative proceedings. That gangrene of the limb was no improbable result of this mode of applying compression must also be evident, if we consider the condition of a limb where a large aneurism exists in the ham; the collateral vessels about the knee are more or less compressed and obliterated; the vein which lies immediately over the sac is also obliterated, and the large nerve stretched and compressed. In such a case, the constriction of the limb above the knee by tight bandages would prevent the return of the blood by the superficial veins, and if the pressure were continued, the limb would very probably fall into gangrene.

This mode of applying compression was necessarily very painful; and must have been intolerable in many cases

where the sac had attained a considerable size; because the large nerve lies between the sac and the integuments, and the principal pain which the patient experiences is frequently occasioned by the stretching and compression of this nerve, which would necessarily be considerably increased by such an amount of pressure as would check or even diminish the pulsation of the aneurism. In addition, when an aneurism is of long standing and of large size, it is often too solid and resistant to be diminished by compression; and the amount of pressure required to lessen or suspend its pulsation must have been considerable, occasioning an amount of pain which in many cases would be insupportable.

This mode of treatment was not only very painful but very tedious, indeed it could hardly fail of being otherwise; because, leaving out of account the necessity there must often have been for the removal of the bandages, on account of the pain they occasioned; equable and steady pressure, so as to check or even diminish the pulsation of an aneurism, cannot be maintained by compresses and bandages; the limb necessarily shrinks after a time, and particularly when bleeding, low diet, and rest, are likewise employed; the bandages then cease to produce the effect intended, which, together with the facility with which they become deranged, would render their frequent renewal necessary.

Finally, that this mode of applying compression was uncertain, appears to be proved by its having failed in more than one-half the cases given by Guattani; and in a larger proportion of those reported subsequently by Flajani and Paletta. When it failed, too, the disease seems always to have been the cause of the death of the patient, except in a few instances where the limb was amputated; even after an apparent cure by this method, the disease is stated by Paletta to have returned.

The theory upon which compression was supposed to effect the cure of aneurism at the period in question was evidently erroneous. There cannot be the slightest doubt that in every case in which it succeeded, the artery at the seat of the aneurism was obliterated; although the main object which surgeons had in view in employing compression was to avoid this very occurrence. They supposed that the aneurismal sac was a bag distended by the blood; that the pressure had the effect of squeezing its contents back into the artery, when the edges of the wounded or ruptured vessels came into contact, and adhered, as in wounds of other parts; and that on the discontinuance of the compression the blood returned to its original channel, and the limb was nourished as before its employment.

Now, as this mode of treatment appears to have been seldom employed except in cases of aneurism of some standing, in which more or less fibrin is always deposited in the interior of the sac, when the tumour is necessarily, therefore, more or less solid, and too resistant to be diminished much by pressure, its pulsation could only have been lessened or suspended by the sac being made to press upon the artery above, and perhaps in some instances also below it; and the cure of the aneurism must have been eventually accomplished by the obliteration of the vessel here. In such cases, the compression of the entire limb by tight bandages tended rather to retard than to accelerate this event, by interfering with the enlargement of the collateral vessels about the knee.

Notwithstanding that the theory upon which compression, as used by Guattani, was erroneous, and that the mode of applying it was objectionable, the contrast between its results, and the only operation for popliteal aneurism then known, is certainly much in favour of the former. Nevertheless, it seems to have fallen almost completely into disuse subsequently, for we read of few cases in which it was

successfully carried out after the publication of Guattani's work. This may, however, in some measure be explained by the fact, that only thirteen years intervened between the appearance of his treatise and the performance of Hunter's first operation for popliteal aneurism.

The only surgeons who have reported cases of popliteal or of femoral aneurism, treated according to this method subsequently, are Flajani, Paletta, and Vicq d'Azyr. Paletta's cases are given in the Giornale di Med. di Milano, and in the Giornale di Venezia. One of Flajani's cases has been already quoted from Guattani's work; the others are contained in his "Nuovo metodo di medicare alcune malattie spettanti alla Chirurgia." Vicq d'Azyr has reported one case of femoral aneurism, in which he succeeded in effecting a cure by the use of a compressing instrument of his own invention. This is figured in the third volume of the Histoire de la Société Royale de Médecine for the year 1779. It is a modification of the tourniquet, the bridge in which the screw works has a pad attached, which is acted on by the latter; and a flat splint covered with leather is connected to it by strong bands by which counter-pressure is made. The pad is laid upon the aneurism and pressure is made by turning the screw, while the splint is applied to the opposite side of the limb. The screw is turned by a key, which can be removed when the proper amount of pressure is made, so that the patient cannot loosen it himself.

During the period we have been considering, a mode of applying pressure, which has been termed *immediate*, in contradistinction to that last described, was occasionally employed. This consisted in laying open the aneurismal sac, clearing away the coagula, and instead of tying the artery above and below, laying graduated compresses upon the vessel, and retaining them by bandages, rollers, &c. Various substances were used for this purpose, as papier

mâché, paper long macerated in water, charpie, sponge, agaric, &c.: these were often previously moistened with styptics or caustic solutions; and learned disquisitions were written upon the superior efficacy of one over the other in healing wounded or ruptured arteries.

This mode of using compression had not, however, many advocates; because if very firm pressure was made, there was a risk of the artery being obliterated at the part; whereas if the pressure was moderate, secondary hæmorrhage was very likely to occur. Indeed Murray relates two cases, where (owing to the latter cause) the patients who had been operated on for brachial aneurism according to this method, bled to death during sleep, from the bandages having become accidentally disturbed.

Sabatier, in his Médecine Operatoire, has described this method, and states that he had seen it several times employed with success in aneurism at the bend of the arm. He relates a case of traumatic aneurism of the femoral artery, in which he employed it successfully himself; being (he says) the second instance on record of its performance; in this, however, he is evidently incorrect, for Guattani has related a remarkable case of inguinal aneurism in which he adopted it, and the patient recovered perfectly. Sabatier (writing in the year 1796) observes, in reference to the operation performed by himself—"It is probable that the success here obtained would not have been interrupted (by secondary hæmorrhage) had the ligature been employed;" but it was the opinion then, that compression could procure the consolidation of the aperture in the artery without entirely obliterating the vessel. Perhaps this takes place when the pressure is moderate, and when the parietes of the vessel are not applied against each other with too much force. However, it is the general opinion now that they adhere together, and that compression and the ligature act in a similar manner.

CHAPTER III.

History of compression in aneurism subsequent to the introduction of the Hunterian operation—The pressure now for the first time applied upon the artery between the aneurism and the heart—Theory upon which compression was used at this period—Experiments of Mr. Freer; cases given by him—Earliest examples of the successful employment of compression upon the artery above the sac in popliteal aneurism recorded by Pelletan, Dubois, and Viricel—Successful cases subsequently reported by Dupuytren and Boyer—Unsuccessful cases recorded during the same period.

Throughout the period we have been considering, the names of but few British surgeons appear in connection with improvements in the treatment of aneurism, and none in connection with the treatment of this disease by compression. In fact, all the instruments for the application of pressure (which have been described) and all the improvements made in this method of treating aneurism, originated with our continental neighbours, amongst whom the French and Italian schools rank foremost. We have now, however, arrived at a period in the history of aneurism of the large arteries at which a great revolution in its treatment was brought about; and at which British surgery took the lead in improving the treatment of this disease, which it has maintained down to the present day.

In the year 1785, Hunter's first operation for popliteal aneurism (according to what is called the modern method) was performed. The great superiority of this operation over that formerly in use can only be fully understood by those who have perused the accounts of the cruel, I might almost say, barbarous operations, practised previous to

that period—operations which were not only painful and protracted, but almost always fatal to life; and which, if the patient escaped after the tedious suppuration which necessarily followed, left behind a contracted state of the joint and permanent lameness. Those who have had the opportunity of dissecting cases of the kind can have but a faint idea of the difficulty which must have attended the application of a ligature, in the living subject, to the artery above and below the sac in a large aneurism seated in the ham, and of the tedious dissection which must have been necessary to accomplish it. Nevertheless, it was not until many years subsequently that the Hunterian method entirely supplanted the old operation; the latter was performed by Boyer so recently as in 1809. Writing in the year 1818, he observes, "in certain cases of popliteal aneurism the old operation is preferable to the Hunterian;" and if the aneurism is seated in the middle of the thigh, or higher up, the old method is alone applicable, because the femoral artery would require to be tied above the origin of the profunda, "which would prodigiously diminish the resources of nature in keeping up the circulation in the limb."

The simplicity of the Hunterian operation, the facility with which it was performed, and the success which attended it when contrasted with the ancient method, led in a great measure to the discontinuance, by British surgeons, of compression in aneurism of the large arteries; and to the almost entire discontinuance of the mode in which it had previously been used. We read no longer of cases of large popliteal aneurism treated by pressure upon the sac; when pressure was used it was applied upon the artery between the aneurism and the heart—an improvement in the mode of its application which evidently sprung from a due appreciation of the principles upon which Hunter's operation was performed.

Nevertheless, owing to the failure of this operation in the hands of practitioners both in England and upon the continent, pressure was occasionally tried either previous to the performance of the operation, or in cases where, from the situation of the aneurism, the operation was deemed impracticable. Thus in two of the cases operated upon by Hunter, it is reported that "compression upon the femoral artery had been attempted previously, but the pain was so great that it could not be continued." In the ninth volume of the *London Medical Journal*, published in the year 1788, Mr. Ford has recorded a case of femoral aneurism which was situated too high up to admit either of amputation or of the application of a ligature, and in which "compression was endeavoured to be made upon the artery in the groin by means of an instrument somewhat resembling a steel truss; but the pain it occasioned when the pressure was strong enough to restrain the pulsation of the tumour, soon obliged us to forego this experiment." The disease was left to itself, and a spontaneous cure eventually took place.

Again, in the eighth volume of the *Medical and Physical Journal* for the year 1802, a case is given in which Mr. Blizard of the London Hospital attempted to effect a cure of popliteal aneurism by obliterating the femoral artery by pressure. The patient eventually came under the care of Sir A. Cooper, who has given the following description of the apparatus used:—"The points of support for this instrument were the outer part of the knee and the great trochanter, a piece of steel passing from the one to the other; to the middle of this a semicircular piece of iron was fixed, which projected over the femoral artery, having a pad at its end moved by a screw, by turning which the artery was readily compressed, and the pulsation in the aneurism stopped, without any interruption to the circulation in the smaller vessels. But although this patient

possessed unusual fortitude of mind and indifference to pain, he was incapable of supporting the pressure of the instrument longer than nine hours, and when it was loosened the pulsation in the tumour returned with unabated force. After a fair trial of this plan the patient left the hospital." He was admitted subsequently into Guy's Hospital, and operated upon with success by Sir A. Cooper.

The principle upon which surgeons applied pressure at this period was to endeavour to excite inflammation of the coats of the artery at the seat of its application: they supposed that if by means of strong pressure the coats of an artery were brought into contact, and retained so, inflammation of the arterial tunics would follow, lymph would be thrown out, adhesion would take place between them, and the obliteration of the artery would be effected in the same manner as if a ligature had been applied. The first to endeavour to determine by direct experiment the effects of pressure upon the arterial tissue, was Mr. Freer of Birmingham, who, in the year 1806, performed a series of experiments upon animals with this object. He found that compression when applied with sufficient force to excite inflammation of the artery and the parts surrounding it, instead of causing lymph to be thrown out in the cavity of the artery, and adhesion of the sides of the vessel, (as was commonly supposed) occasioned an effusion of lymph about the artery and between its coats, by which its tube was so much compressed as to be impervious to the passage of blood. Two of his experiments we shall quote:

"*Experiment* 1.—December 5th, a tourniquet was applied, and a pad fixed upon the left radial artery of a horse, and a wide wooden splint was fixed on the opposite side of the limb to prevent the circulation being interrupted in the collateral vessels. On the evening of the same day the limb was much swelled, but retained its natural heat. On the evening of the 6th the tourniquet

was removed until the middle of the following day, when it was again applied. By this time the œdema and swelling of the limb had greatly increased, and the heat was much more than natural. The pressure was removed about eight o'clock a.m., December 9th, and the animal was killed at two the same day."

"Upon dissection, a great effusion of serum was found in the cellular membrane from the place where the tourniquet was applied to the hoof. There was also a small effusion above the tourniquet. There was great inflammation of the cellular membrane, fascia, and muscles which lay under the pad of the tourniquet. The artery lay imbedded in a quantity of coagulable lymph, effused into the cellular substance surrounding the vessel, and externally it appeared inflamed. The upper part of the artery exhibited no signs of disease: but when an incision was made along it, an effusion of lymph was found in its internal coats, which swelled them to that degree as to obliterate the cavity by pressing its sides in contact with each other for the space of an inch and a half.

"*Experiment* 2.—A tourniquet was applied, in the same manner as in the former experiment, to the radial artery of a horse, on the 16th of December. The following day the limb became œdematous: at night the tourniquet was a little slackened, but on the morning of the 18th it was again tightened, and continued so until the 20th, when the tourniquet was removed. On the 22nd the animal was killed.

"Upon dissection, there was not so much exudation of lymph below the compression as in the former experiment. Around the artery there was much inflammation, but no inflammation of the artery itself. For two inches above and below the pad, it was so much diminished in its cavity as with much difficulty to admit of the introduction of a bristle, and immediately under the pad, a small plug of

dark-coloured coagulum was formed, below which was a considerable protuberance in the coats of the vessel impeding the passage of the blood. The obstruction was further increased by a great thickening of the coats of the artery, which had become almost of a cartilaginous texture."

The work in which Mr. Freer's experiments are recorded was published at Birmingham in the year 1807. In it he has given the details of two cases of aneurism, one of the femoral, the other of the popliteal artery, which were cured by compression of the entire limb by bandages and compresses. Neither of the cases were treated by Mr. Freer, and as this method of applying pressure has already been fully illustrated, it will only be necessary to quote one of them here.

"The patient, a guard of a mail coach, aged 35, ascribes the disease to a sudden jerk which he received in jumping off the coach. The knee became generally swollen, and a small pulsating tumour was felt in the ham, which gradually increased and in a few weeks attained the size of a large orange, pulsating violently, and producing much pain in the part, though the limb itself was benumbed. The compression was made by means of a roller carried from the toes up the leg and over the tumour. A small pad of linen was then applied to that part of the artery where it passes round the inner side of the thigh to get at the ham. The compress was then firmly bound down by the remaining turns of the roller, which was continued up the thigh. During the application of the roller, the lower limb was affected with agonizing and almost intolerable pain. It was, however, after one of these urgent paroxysms that the pulsation in the tumour was found to have ceased. The roller was continued for some weeks, during which the tumour considerably diminished. He was seen two years afterwards and experienced no inconvenience except a little lameness."

Mr. Freer is an advocate for a trial of compression in all cases of aneurism which admit of its application. "In the cases where compression has been hitherto used, (he observes) it has been upon the tumour itself; and although this mode of application has frequently been attended with success, it is by no means so likely to answer the intention of uniting the sides of the vessel as when used on the sound part of the artery. From the result of the experiments upon the radial artery of the horse, I should recommend the pressure to be applied on the extremities, either by the assistance of Senffio's instrument, or in the following manner.

"Apply a bandage moderately tight from one extremity of the limb to the other, and place a pad upon the artery a few inches above the tumour; then, with a common tourniquet surrounding the limb, let the screw be fixed upon the pad, having previously secured the whole limb from the action of the instrument by a piece of board wider than the limb itself, by which means the artery only will be compressed when the screw is tightened, the tourniquet should then be twisted till the pulsation in the tumour ceases. In a few hours, as by experiment in the horse, the limb will become œdematous and swelled; the tourniquet may then be removed, and no stronger pressure will be required than can easily be made with the pad and roller. The irritation produced by this mode of pressure excites that degree of inflammation of the artery which deposits coagulable lymph in the coats of the vessel, thickens them, diminishes the cavity, and eventually obstructs the passage of the blood."

The earliest examples of popliteal aneurism successfully treated by compression upon the artery above the tumour were recorded in the year 1810. The first is noticed by Pelletan in his Clinique Chirurgicale, published in that year, but the details are given very briefly. This case is

related more at length by Richerand in the article Aneurysme in the second volume of the Dict. des Sciences Médicales, published in 1812; and still more fully by Boyer in the second volume of his Traité des Maladies Chirurgicales, published in 1818.*

The patient was a grocer living in one of the streets of the Isle St. Louis, Paris. The aneurism was seated in the ham, was of moderate size, and had a strong pulsation; there was no swelling of the limb. In consultation with Deschamps, Pelletan, Dubois, and Boyer, compression upon the artery above the tumour was recommended, because, as the aneurism was neither of long standing nor of large size, there was no immediate necessity for an operation; besides, supposing that compression failed, it would be likely rather to favour the success of a subsequent operation. The patient having been made acquainted with the decision, was persuaded by a locksmith of his acquaintance to employ an instrument, which the father of the latter had invented, and had used with success upon himself when labouring under a similar disease. This Boyer states to have been a kind of tourniquet of a rather ingenious construction; Richerand describes it as a modification of a truss, with a screw and pad attached. M. Eschard, who had the charge of the patient, applied the compress upon the femoral artery, just above its passage through the tendinous canal in the triceps muscle. At first the pain it occasioned was so great that it had frequently to be relaxed; but by degrees the patient became accustomed to it, and at the end of eleven months, during

* With the exception of this case, the editor of the *Dublin Quarterly Journal of Medicine* (in his history of the cure of popliteal aneurism by compression, to which I have before had occasion to allude,) has overlooked all the examples which follow of the successful employment of this method of treatment.

which he had remained perfectly at rest, restricted himself to a low diet, with a bleeding once a month, the aneurism ceased to pulsate, the tumour became small and hard, and ultimately entirely disappeared.

The second case occurred in the practice of Dubois, and the patient was presented to the Faculté de Médecine at a meeting held March 29th, 1810. The case is recorded in the second volume of the Bulletins de la Faculté de Médecine.

The patient, a carter, aged 27, began to complain three months previously of pain and lameness in the left lower extremity, which became so severe in January that he was obliged to give up his occupation; at this time he first perceived a pulsating tumour in the popliteal space. By the 5th of February the aneurism had acquired the size of a large pigeon's egg, it pulsated strongly, and the pulsation could be checked by pressure upon the femoral artery; the colour of the skin was unchanged. The patient could neither walk nor stand without suffering much pain, which extended from the ham to the back of the leg and the outside of the foot.

M. Dubois having determined to try the effect of compression upon the artery in the middle of the thigh, a preparatory bandage was applied over the tumour until the 24th of February, which produced no other change than a slight diminution in its pulsation. On the 25th an apparatus, constructed expressly for the purpose, was applied; this consisted of a semicircle of iron, both extremities of which terminated in pads; one was applied upon the exterior of the thigh, the other upon its internal surface exactly opposite; to the latter a screw was attached, by turning which pressure upon the artery was made. On the 28th of February the pressure was increased; by the 2nd of March, the pulsation in the tumour was perceptibly diminished. On the 7th, still stronger pressure was made,

so as to check altogether the pulsation in the aneurism. Towards evening, the pressure became so painful that the patient removed the apparatus, when he found that the pulsation had entirely ceased. The apparatus was replaced, and by the 12th, the tumour had become hard and small. On the 18th, it was removed altogether, but the patient was not permitted to leave his bed for some days longer. On the 29th, he was presented to the Faculté de Médécine perfectly cured.

The instrument employed in this case would appear from the description to have been very nearly similar to some of those recently used for the same purpose; it evidently served as the model of the compressor which bears Dupuytren's name.

On the 22nd of November, in the same year (1810), Viricel, surgeon to the Hôtel Dieu de Lyon, communicated to the Faculté de Médecine two cases of aneurism cured by compression; the details are not, however, given, nor is it even stated where the aneurisms were seated; but it is probable that they were cases of popliteal aneurism, because Lisfranc in his work on Aneurism mentions that Viricel had succeeded in curing more than one case of popliteal aneurism by pressure upon the artery above the tumour.

In the year 1811, the subject proposed by the Royal College of Surgeons of London for the Jacksonian prize was—"Wounds and Diseases of Arteries and Veins." Mr. Hodgson was the successful competitor, and his essay formed the groundwork of the valuable treatise upon aneurism which he afterwards published. In a former year the proposal of a similar subject by the Societé de Médecine of Paris, for their prize, led to the publication of Scarpa's work. From the year 1810, however, down to 1818, no cases of femoral or of popliteal aneurism have been recorded, in which pressure was successfully used;

although this proceeding was occasionally had recourse to previous to the performance of the operation. Thus, in the seventh volume of the Medico-Chirurgical Transactions, in a paper upon aneurism by Sir Philip Crampton, a case is given in which compression by an instrument, similar to that used by Sir W. Blizard, was tried by Mr. Adrien, "but by no force that could be borne was he able to stop the pulsation at the ham;" the attempt was therefore abandoned.

Mr. Hodgson states that "in the only instance in which he has known compression to be used, the patient insisted on the removal of the instrument in less than an hour after its application; the pain which was produced by continued pressure was insupportable." In a note he adds, that he was informed by a friend of another case of popliteal aneurism, in which pressure could not be supported longer than two hours. "The compression of the femoral artery was effected by means of a tourniquet, a broad piece of wood being placed upon the opposite side of the limb, so as in some degree to prevent pressure upon the collateral vessels."

In the thirteenth volume of the *Edinburgh Medical and Surgical Journal*, Dr. A. Robertson has given a figure and description of an instrument which he used in one case of femoral aneurism. This consisted of a flat splint which was placed in an oblique direction under the hip, having a semicircular piece of iron passing over the thigh, which was attached at each extremity to the back splint. This was pierced for a screw, which terminated in a button; a graduated compress was laid upon the artery, and the button of the screw upon it; by turning the screw, the circulation in the artery was checked. The instrument was kept in its place by two or three turns of a roller carried round the body. The patient was prepared by bleeding and purgatives; the compress was laid upon the

artery as it passes under Poupart's ligament, and compression made so as completely to check the pulsation in the aneurism. "The instrument remained on the limb for forty-eight hours, (with only two or three intervals of a few minutes) when the pain from the continued pressure became so excessive that he was unable to bear it longer."

At a meeting of the Faculté de Médecine, held on the 5th of November, 1818, Dupuytren presented a patient who had been cured of popliteal aneurism by pressure upon the artery in the middle of the thigh, by means of the instrument which bears his name; at the same time he stated that this was the second case in which he had employed pressure successfully in popliteal aneurism.*

The patient was a Pole, aged 30; the aneurism, which was seated in the ham, was of several years' standing, of the size of a turkey's egg, and was accompanied by very severe pain, which prevented the patient using the limb, and the motions of the joint were lost. Dupuytren proposed the operation, but the patient refused to submit to it. The compressing instrument was then applied upon the artery in the middle of the thigh, the patient was instructed how to use it, and was directed to relax the pressure whenever the pain became very severe; ice at the same time was applied to the tumour. About the 5th or 6th day the pain subsided, the sensibility of the limb returned, and the patient was able to move the joint a little; the aneurismal tumour had diminished in size, and on removing the instrument the pulsation of the aneurism was found to be less strong. On the 20th day the pulsa-

* The editor of the *Dublin Quarterly Journal of Medicine*, with his usual accuracy, observes, in reference to the employment of compression in aneurism by Dupuytren, "about the year 1817, the Baron Dupuytren *is said* to have cured a case of popliteal aneurism by pressure; but Mr. Adams, who witnessed it, informs us that it did not turn out successfully."

tion in the ham being no longer felt on the discontinuance of the pressure, the patient removed the instrument. A month afterwards he was examined by Dupuytren, the aneurism was perfectly cured, he had good use of the limb, and nothing remained in the site of the tumour but a hard knot, the size of a pigeon's egg, which diminished daily.

The instrument employed in the foregoing case goes under the name of Dupuytren's compressor. It consists of a semicircle of solid steel, having at one extremity a large concave cushion adapted to the posterior part of the limb; and at the other extremity a pad, which, by means of a spiral spring and screw, can be approximated to it. The pad is applied upon the artery we intend to compress, and by turning the screw pressure can be made to the requisite degree, the cushion affording the counter-pressure. Thus the compression is limited to two points upon the opposite side of the limb, and the main artery of the limb can be commanded without interrupting the current in the collateral vessels or superficial veins. Dupuytren was in the habit of employing this instrument in amputation in place of the tourniquet.

In the second volume of Boyer's treatise on Surgery, published in the year 1818, we find another example of popliteal aneurism, in which compression was employed with success; Boyer had treated the case many years previously, but it was then for the first time published.

"The patient, a boatman, aged 44, was admitted into La Charité on the 1st of February, 1805. The aneurism was seated in the right ham, had followed a sudden extension of the limb, and was of three months' duration. The tumour was about the size of an egg, was circumscribed, soft, pulsated strongly, and was partly reducible by pressure; compression upon the femoral artery checked its pulsation, and diminished its size. The limb was slightly swollen, but this disappeared after a few days rest.

Compression upon the femoral artery immediately above where the vessel passes through the tendinous canal in the triceps muscle was commenced, "the compressing instrument of Hunter" being employed; the pressure at first was very moderate, and the patient was sufficiently docile; but in the course of two or three months, much more firm pressure being used, the foot and thigh swelled, the patient complained of a sense of weight in the limb, and loosened the apparatus himself. The compression then was only used at intervals; after a time, however, he supported it better, and by the month of September, 1806, (when Boyer was obliged to leave Paris to accompany the Emperor in the Prussian campaign,) the tumour felt solid, had diminished in size, and the pulsation was less evident.

The pressure having been now continued for twenty months, Deschamps proposed the operation, and the patient gave his consent, but asked leave to return home for a few days, in order to arrange some matters. He left the hospital on the 2nd of October, and returned in fifteen days; although he had been obliged to walk much in the interval, the aneurism had not increased in size, and its pulsation was no stronger than before. Deschamps therefore resolved to wait a little longer, and the compressing instrument was again applied. On the tenth day after its reapplication the patient stated, that on removing it, pulsation was no longer to be felt in the tumour; nevertheless, the compression was continued for eight days longer, when the patient was permitted to move about: the tumour became harder, and diminished daily, and he left the hospital on the 30th of November. He was seen frequently afterwards; nothing remained of the aneurismal swelling but a hard cord in the centre of the ham; the patient had perfect use of the limb.

In the ninth volume of the Medico-Chirurgical Transactions, published in the same year, Dr. Albers of Bremen,

has reported a case of inguinal aneurism cured after the use of compression. In this case the pressure was applied directly upon the aneurismal sac, and the instrument used was similar to that already described as having been figured by Heister. "It consisted of a cushion fastened to a strap, which was buckled round the body. On the lower and inner side of the cushion there was also a strap, which was fastened round the thigh by means of a buckle. The cushion itself consisted of two iron pieces: the uppermost had the form of a common cushion, and was externally covered with leather: the lower piece was round and covered below with strong cloth, and above with leather. It was connected with the upper piece by a screw, by the operation of which its pressure on the tumour could be increased or diminished at pleasure."

The foregoing are the only examples of the successful employment of compression in aneurism of the large arteries which, down to this period, have been recorded. The latter, however, cannot properly come under this head, as the direct pressure upon the tumour appears to have caused inflammation in the sac and parts about it, which led to the obliteration of the artery above it. The cases in which compression is reported to have failed are still more numerous; Boyer has given the details of four in which he tried it, and Dupuytren two, in which this method was equally used without success.

In the first of Boyer's cases, the aneurism which was seated in the ham, occurred in a female. Compression was applied to the artery in the thigh by means of "Hunter's apparatus." On the 30th day, although the pressure was not sufficient to check completely the pulsation in the aneurism, the patient complained much of the pain. On the 50th day the pressure had caused an eschar at the part, and the instrument had to be removed. In about three weeks it was reapplied a little higher up, and continued

for three months, when the same cause obliged it to be again removed. It was tried a third time, but an eschar having again formed, it was abandoned, and the operation of laying open the sac performed with success.

In the second case pressure was applied by means of compresses and bandages, but the patient suffered so much pain that it had to be given up, and the same operation was performed with success.

The third case was also one of popliteal aneurism; the patient was admitted into hospital in March, 1809. The pressure was applied upon the artery in the thigh by the same instrument which had been used on a former occasion. It was continued for three months, the site of its application being occasionally changed, and its employment occasionally intermitted. At the end of this period the pressure was abandoned, although it is stated that the pulsation of the internal superior articular artery had become very perceptible; the operation of laying open the sac was then performed, and the patient died.

In the fourth case reported by Boyer, the patient had an aneurism in the ham, and another a little below Poupart's ligament upon the same side. On admission into La Charité in February, 1816, the leg was in a state of gangrene, and the limb was amputated above the knee. Nine days afterwards ice was applied to the other aneurism, combined with pressure upon the artery as it passes under Poupart's ligament, which, although used imperfectly, occasioned in the space of four days a diminution in the size of the aneurism, and lessened its pulsation; but the stump swelled, and an abscess formed in it, which did not, however, materially interfere with its healing, which took place at the end of fifty days.

The ice and pressure were continued, and on the 8th of May graduated compresses and a bandage were applied along the stump, so as to check the pulsation of the

aneurism, but the patient left the hospital a few days afterwards. At this time the aneurism was much smaller and harder, and its pulsation much less strong than upon the patient's admission. He continued to employ the bandage and compresses until the month of March, 1818, at which period it is stated the pulsation of the aneurism was feeble, but still perceptible.

At a meeting of the Faculté de Médecine, held in July, 1819, Dupuytren presented two patients upon whom compression had been tried by him, but without success; and on whom he had afterwards operated. In one of these cases the aneurism was seated high up in the femoral artery; he employed an instrument by which pressure could be made upon the artery as it passes over the ramus of the pubis, the counter-pressure being upon the sacrum; but as it was readily displaced he had another constructed somewhat upon the principle of a truss, which, from the description, resembled that figured by Heister. After a trial of ten days the patient refused to continue its use, although at this period "the aneurismal tumour had been reduced to two-thirds of its original volume, and the strength of its pulsation had sensibly diminished."

Dupuytren concluded from these and several other analogous cases, "that there are individuals who cannot bear compression, whilst there are others who support it without inconvenience, and that this is the only reason of the different results of compression as applied to the treatment of aneurism."

CHAPTER IV.

History of compression in aneurism subsequent to the introduction of the Hunterian operation, continued—Cases recorded by the late Mr. Todd in the Dublin Hospital Reports—First successful case communicated to the Surgical Society of Ireland by Mr. M'Coy—Successful case treated by Mr. Todd—Successful case recorded by M. Verdier—Immediate compression of the artery leading to the aneurismal sac—Description of the presse-artère of Deschamps, Ayrer, Percy, Duret, Dubois, Assalini, Crampton, and Ristelhueber—Successful cases treated by Sir Philip Crampton—Compression of the artery at the distal side of the aneurism—Cases in which this method has been tried.

Compression as a mode of treating aneurism never appears to have had many advocates in this country. When the late Mr. Colles first entered on practice in Dublin, there was but one way (he observes in his lectures) of attempting the cure of popliteal aneurism, and that was by amputation; but from the period at which the Hunterian operation became established, down to a very recent date, the ligature was almost solely relied upon, and its superiority over every other kind of treatment was taught and enforced both by reasoning and example; if any innovation was permitted, it was in improving upon or in facilitating the Hunterian operation. Consequently we read of few cases in which compression was tried; and of still fewer in which it was persevered in for any length of time.

Amongst the earliest recorded cases are two by the late Mr. Todd: these are contained in the third volume of the Dublin Hospital Reports, published in 1822, in a paper entitled—"A Report on cases of Aneurism in which

operations were performed in the Richmond Surgical Hospital, Dublin." In this communication, after detailing two cases in which he tied the external iliac artery, Mr. Todd has related two of popliteal aneurism, in which compression on the artery in the groin was tried for a time; but in both of which the operation was subsequently performed. As the volume in which these cases are contained is now scarce, I shall quote them here.

The subject of the first case was a farmer, aged 30, who was admitted into hospital, July 30, 1820. The aneurism which was seated in the right ham, was rather larger than an egg, and had been first noticed about five weeks previously. It pulsated very strongly, its contents were quite fluid, and it could be completely emptied by pressure.

"The disease in this case was so recent that it was resolved to watch its progress for some time before an operation should be decided on. The patient was accordingly directed to remain in the horizontal posture; he was put upon a low regimen, and occasionally blooded and purged.

"The tumour was so much under the control of pressure on the inguinal portion of the artery, that I was not altogether without hope (Mr. Todd writes) that by diminishing the current of blood in the trunk of the artery, so as to favour the coagulation of the contents of the sac, a cure without operation might be effected; at all events, it was obvious that by giving time to the collateral arteries to be dilated, the success of the operation would be rendered less uncertain." Accordingly, "I constructed an apparatus resembling a truss for femoral hernia, the spring of which was much stronger, and the pad longer, of a more oval form, and more firmly stuffed than in the truss. The pad was furnished with an inner plate of iron, which was connected with the outer iron plate by means of a hinge close to the junction of the outer plate with the spring,

and a tourniquet screw passing through this plate had the effect, when turned, of making a greater or lesser degree of pressure with the pad on the part to which it was applied.

"The instrument (a figure of which is given) was put on like a common truss, the pad being placed in the line of the crural artery, immediately below Poupart's ligament; and it was kept in its place by a strap which passed from the spring of the truss behind and buttoned in front on the outer plate of the pad. The principle of the instrument, and the object for which it was employed, were explained to the patient, so that he was enabled to regulate the degree of pressure according to his sensations; after a trial, however, of several weeks, he could not be persuaded that the plan adopted was productive of benefit; during this period the tumour had obviously diminished, and its contents had acquired a firm consistence, but the patient complained that the instrument gave him much pain, and that his health, &c., had suffered; the operation was accordingly performed."

The subject of the second case was a labourer, who was admitted into hospital, July 17, 1820. The aneurism was seated in the left ham, was larger than a turkey's egg, pulsated strongly, and was very painful; the integuments covering the tumour appeared thin, and a thrill was felt, resembling that of the aneurismal varix. Pressure on the tumour or on the artery in the groin removed both pulsation and tumour.

"The same plan of treatment was pursued in this case as in the former; but the patient being more robust and plethoric, depletion was carried to a much greater extent. In a few weeks no alteration could be perceived in the tumour, but he became impatient, and was unwilling to submit to a continuance of that rigid discipline, which it had been thought expedient to adopt. Towards the latter

end of August the tumour obviously increased and assumed a conical form; at one point the integuments felt very thin, and here the tumour was particularly prominent, conveying to the touch a sensation as if some of its immediate coverings had yielded, and the sac had protruded towards the surface. The peculiar thrill was also more distinct than on his admission, and the swelling of the leg had become greater;" the operation was accordingly performed.

The compressing instrument employed in the foregoing cases is almost exactly similar to that already described as having been figured by Heister and employed by Albers and others.

The first case of aneurism of a large artery, in which compression was employed with success in this country, occurred in Dublin in the year 1824. The particulars were not, however, made public until the year 1843, when Mr. M'Coy brought the subject before the Surgical Society of Ireland at a meeting held April 8, in that year. An outline of the case is contained in the Medical Press for April 26, 1843, and it has been republished by Mr. Adams in the last number of the *Dublin Quarterly Journal of Medicine*. But as the exact period at which the compression was commenced, and the date of the cessation of the pulsation in the aneurism, with some other particulars, are not given in Mr. M'Coy's communication to the Surgical Society, I avail myself of the notes of the case which he has since kindly placed in my hands.

"The patient, a revenue tide-waiter, aged 26, of robust constitution, but of most intemperate habits and reckless disposition, was put in charge of a vessel lying at the Custom-house quay on the 2nd or 3rd of February, 1818. Some days after, as he was ascending the side of the vessel, he felt a sensation as if something had given way in the left ham, but he took no notice of it until he began to

experience stiffness and slight pain about the joint; in rubbing the knee at this time he thought he felt a little swelling in the ham; upon this point, however, he was not very clear. A short time afterwards, while in a state of intoxication, he made some violent exertion, and the aneurism in the ham became diffused, but more than a week elapsed before he applied for the attendance of Dr. Duggan, the surgeon to the revenue; amputation of the limb above the knee was decided on, and performed on the 25th of March. In eight weeks afterwards the patient was able to attend his duty.

"In the month of May, 1824, he observed a pulsating tumour in the line of the femoral artery of the stump, about an inch and a half below Poupart's ligament, which gradually increased in size, and in the August following, when first examined, had attained the size of a turkey's egg. All the circumstances of the case being taken into consideration, the operation was deemed unadvisable, and Dr. Duggan determined to try Mr. Todd's instrument for compressing the artery in the groin. Mr. Todd had the kindness to lend his own instrument, which I applied on the 27th of August. I had considerable difficulty with the case during the progress of the treatment; the instrument was clumsy, the patient intractable, and almost constantly excited by liquor, and the part to which alone the pressure could be applied was most inconveniently situated for its effective action, which, with the other circumstances mentioned above, rendered hopes of success exceedingly slight; compression was notwithstanding persevered in, and by the 20th of October, all pulsation had ceased in the aneurism; a fortnight afterwards there had been no return of the pulsation, the tumour was solid and flatter upon the surface; eventually the patient perfectly recovered, and he was alive several years afterwards." Mr. Adams states that this patient lived for twenty years after

the cure of the aneurism ; in the year 1842 he was under his care in the Richmond Hospital for rheumatism. He died in September, 1844, his death being caused by his intemperate habits.

The next case in which compression was successfully employed in this city was treated by the late Mr. Todd in the year 1825 ; the particulars of it were not, however, made public until the month of August, 1846, when the notes of the case were communicated by Dr. Robert Todd of London, to the *Dublin Quarterly Journal.* Mr. Todd's death soon after it occurred is stated to have been the cause of the delay. I shall give it in the words of the reporter, premising that it is unaccompanied by any remarks upon this method of treating aneurism.

The patient, aged 36, a labourer in a brewery, was admitted into hospital, September 5, 1845, labouring under popliteal aneurism on the right side. "The aneurism is about the size of a turkey's egg ; it lies across the popliteal artery, and extends laterally under the hamstring tendons, so that by looking at the front of the thigh, it can be seen pulsating on either side. Its contents seem to be fluid, as by making pressure upon the sac its size can be much diminished. The pulsation is easily commanded by pressure on the femoral artery below Poupart's ligament."

The previous history of the case is then given, which it is not necessary to quote. "On his admission he was ordered to keep his bed, and have a dose of purgative medicine.

"Thursday, 8th. Complains of headache; tongue white; pulse 100.—Bleeding to twelve ounces ; mist. purgans.

"17th. The tourniquet truss was applied at twelve o'clock, which perfectly commanded the pulsation of the tumour, but it returned in two hours after the application of the truss ; in the evening it was screwed tighter ; pulsation ceased but for one hour.

"18th. The instrument not appearing to fit, was removed, and sent to be altered.

"21st. The instrument was again applied, (it appeared to answer perfectly) and was kept on till eight o'clock p.m., when it was removed, as the man could no longer bear the pressure; the pulsation in the sac less violent.

"22nd. The instrument was applied at twelve o'clock, and continued till the 24th; the pulsation in the tumour has entirely ceased; pressure was applied on the tumour by graduated compresses and a roller, wetted in a solution of muriate of ammonia.

"25th. The instrument was not applied yesterday (through mistake), however there is no pulsation in the tumour. It was applied on the morning of the 25th, and remained on till Tuesday, 27th, when it was removed entirely.

"28th. No pulsation; tumour is diminishing."

The editor of the *Dublin Quarterly Journal of Medicine*, in his "History of the cure of popliteal aneurism by compression," (to which I have before had occasion to allude,) in commenting upon the foregoing cases, has made some extraordinary assertions, which this appears to be the proper place to notice. 1st. He asserts that the late Mr. Todd was the first in these countries to effect the cure of aneurism of a large artery by compression. "What we are anxious to establish is (he observes, the italics also are his own,) that *the first successful case of popliteal aneurism treated by compression in these countries was in the practice of the late Mr. Todd.*" 2nd. He asserts that the entire merit of this mode of treatment is due to Mr. Todd. "We had (he observes) in common with many others in this city, a traditional knowledge that the entire merit was due to that distinguished surgeon; and this opinion was confirmed by conversing on the subject with Sir P. Crampton, Mr. Cusack, Mr. Adams, and others

who had personal recollections of the cases treated by Mr. Todd." 3rd. He asserts that Mr. Todd was acquainted with the principle upon which compression effects the cure of aneurism. "From a careful examination of this case, we learn (he observes) that Mr. Todd was perfectly acquainted with the *principle* of the operation."

That the first case of aneurism of a large artery successfully treated by compression in these countries was *not* in the practice of the late Mr. Todd, must be sufficiently evident, because I have just detailed a case of femoral aneurism treated in this city by Mr. M'Coy a year previously; Mr. M'Coy's case was detailed at a meeting of the Surgical Society of Ireland, and the particulars were published in the DUBLIN MEDICAL PRESS three years before Mr. Todd's successful case; finally, it has been republished, with the dates of the respective cases, in the very communication in which the editor of the *Dublin Quarterly Journal* has made this extraordinary assertion.

2ndly. That the entire merit of this mode of treatment cannot be due to Mr. Todd is sufficiently evident from the cases I have already detailed, in which precisely the same mode of treatment was adopted. Besides, I have shown that the instrument even which Mr. Todd used was not original, but had been described long ago by Heister, and had been employed in several of the cases which have been recorded since.

3rdly. That Mr. Todd was *not* acquainted with the principle upon which pressure effects the cure of aneurism is clear, because in his paper in the Dublin Hospital Reports he recommends the employment of compression, not with a view of curing aneurism, but as a preparatory step previous to the operation.

"The cases of popliteal aneurism (he says) are related chiefly with a view of recommending a more general adoption than is at present practised of a preparatory

course previously to operation. I can scarcely doubt but that in many cases of aneurism in which operations have failed from mortification of the limbs succeeding, the patient might have been saved by a delay sufficient to allow some progress to be made in establishing the collateral circulation; and I feel confident that this desirable object may be promoted in most instances of recent disease, situated at a sufficient distance from the trunk, by compressing the principal artery of the limb for a few hours every day for a period which must vary according to the circumstances of the case."

In the appendix to the article "Aneurism" in Cooper's Surgical Dictionary, a list of writers upon the subject is given, in which Mr. Todd's essay is alluded to as follows:—

"*Todd's cases in the Dublin Hospital Reports, vol. iii.*—He is an advocate for trying compression previously to the operation, with the view of making the collateral vessels enlarge, and removing the risk of gangrene from insufficient circulation after the ligature is applied."

If additional evidence were required it is afforded by the fact that none of Mr. Todd's cotemporaries, with one exception, ever even gave this method a trial; and in this instance it was very soon laid aside. We learn from the *Dublin Quarterly Journal* that "in the year 1826, shortly after the cure of Mr. Todd's case, Mr. Cusack was lent the instrument, and tried it upon a case in Stevens's Hospital; but as the subject was very impatient, and bore the pressure badly, he performed the usual operation, and the patient recovered." Lastly, the late Mr. Colles, who was Mr. Todd's colleague, both as editor of the Dublin Hospital Reports, and as Professor of Surgery to the Royal College of Surgeons in Ireland, in speaking of compression in aneurism (in his lectures published recently in the DUBLIN MEDICAL PRESS,) neither alludes to Mr. Todd's cases, nor recommends a trial of this method.

Indeed he rather discourages a trial of compression; "the effect of the old practice (he says) of keeping a compress along the artery, with the view of enlarging the anastomosing vessels, and diminishing the force of the blood going to the aneurism, is generally to occasion secondary hæmorrhage." Professor Porter in his work on Aneurism, published in Dublin within the last few years, in speaking of compression as a mode of treatment, does not mention Mr. Todd's name, or allude in any way to his cases. Finally, several cases of aneurism at the bend of the arm, the result of a wound of the artery in bleeding (treated by compression in Stevens's Hospital by Mr. Cusack) have been recorded in the first volume of the *Dublin Journal*, published in 1832. In this communication there is not only no allusion to Mr. Todd's cases, but the pressure was applied in quite a different way, "care being taken that the compression did not extend above the aneurism;" and one of the conclusions the reporter draws from the foregoing cases, is, "that the pressure should be applied to the tumour alone, and not to the artery above."

In its proper place I shall prove that the principle upon which compression effects a cure of aneurism was a much later discovery. But here I wish to observe, in justice to Mr. Todd, that in his essay in the Dublin Hospital Reports, he has stated fairly the objects with which he employed pressure; he does not insinuate that he used it upon any new principle, or that there was any novelty or originality in the mode in which he employed it. If the facts were as the editor of the *Dublin Quarterly Journal* asserts, Mr. Todd's friends would have been culpable in holding back his claims so long, and in allowing them to remain in abeyance until others had developed the principle, and until the value and efficacy of this mode of treatment had been fully proved by others.

The only other case of aneurism recorded during the

period we have been considering, in which compression was successfully carried out, occurred in the practice of Verdier. The case was one of femoral aneurism seated high up; the patient had previously laboured under popliteal aneurism upon the same side, and the limb had been amputated above the knee. An aneurism subsequently developed itself in the femoral artery of the stump, and Verdier succeeded in effecting a cure by the use of an instrument resembling in shape a hernia truss, but provided with a second pad acted on by a screw. The pressure was applied to the artery as it passes over the ramus of the pubis; after a time the tumour diminished in size, became solid, and finally ceased to pulsate. The successful termination of this case (M. Begin observes) seems to have been in some degree owing to the patient himself; the experience he had had formerly made him alive to the dangerous nature of the disease, and he exhibited a degree of resolution and patience seldom found under ordinary circumstances.

IMMEDIATE COMPRESSION OF THE ARTERY LEADING TO THE ANEURISMAL SAC.

Subsequent to the introduction of the Hunterian operation, owing to its occasional failure, or more probably in consequence of the theoretical views adopted by surgeons respecting the best means of obliterating arteries, a mode of applying compression which has been termed *immediate*, was occasionally employed. This combined an operation with compression, and consisted in laying bare the artery in the usual situation for the application of a ligature; but instead of tying the vessel, an instrument, by means of which the sides of the artery could be gradually pressed together, was applied, and retained upon the part until "a sufficient degree of inflammation had been excited to

occasion adhesion between the opposite surfaces of the artery and obliteration of its cavity."

Very soon after the introduction of the Hunterian method, this mode of operating seems to have been proposed; indeed Hunter himself may be said to have performed a modification of it. In his earliest operation he used four ligatures, which were tied "so slightly as only to compress the sides of the artery together," as he wished "to avoid great pressure upon the vessel at any one part, and to compress such a length of artery as might make up for the want of tightness." Scarpa, whose opinions exercised for a long period considerable influence, was also an advocate of this mode of applying the ligature. He laid it down that "the degree of pressure should be only such as to put and keep the two opposite sides of the artery in complete and firm contact;" and he employed for this purpose "two waxed tapes, each two lines in breadth, with a cylinder of linen placed lengthwise upon the part of the artery where the knot was made." This method of operating was extensively employed upon the continent, and various substances were used in place of the cylinder of linen, sometimes a piece of cork or a piece of wood wrapped in lint, sometimes a piece of bougie, of leather, or of agaric. The object they all had in view was the same—viz., to prevent the division of the inner coats of the artery, and to endeavour thus to diminish the chances of secondary hæmorrhage.

The foregoing theory led to the invention of instruments of different forms and shapes by which the opposite sides of an artery could be pressed together and retained in contact. It was supposed they would have some advantage over the ligature, because they could be tightened from time to time as might be considered advisable, and they could be removed when the necessary degree of inflammation had been excited in the coats of the artery.

We find the names of Deschamps, Percy, Dubois, Assalini, and Crampton, among the advocates of this plan of obliterating arteries, or as inventors of instruments for the purpose. This mode of operating, although it appeared very plausible in theory, was not found to answer in practice, and of late years it had been in a great measure abandoned. Indeed, as has been observed in reference to it, "when the operator has been at the trouble of laying bare a large artery, the application of the ligature being more simple in its execution, and more certain in its results, is justly preferred by the majority of surgeons."

Deschamps, in the year 1796, appears to have been the first to invent and employ an instrument for immediate compression; this was named a *presse-artère*, or a *serre-artère*, and consisted of a metal plate with a stalk or stem attached; the plate was seven lines in length, and was pierced by two holes; the stem was two inches and a half in length, and had a hole at the opposite end from the plate. The mode in which it was applied was as follows: A flat ligature having been passed under the artery, the plate was laid upon the denuded vessel, and the two ends of the ligature were passed through the holes in the plate, and then in opposite directions through the hole in the stem, in which they were secured by means of a peg. The artery was thus compressed between the ligature and the plate of the instrument somewhat in the same manner as the neck of a polypus is by the canula and ligature. Deschamps has reported cases where he employed this instrument with success.

In a work upon aneurism and its surgical treatment by Ayrer, published at Göttingen in the year 1800, we find a figure and description of a presse-artère, which appears to be an improvement upon that of Deschamps; it consists of a stem and plate like the former; the plate is similar, but the stem which is forked above is traversed by a

screw, which has a hole in the centre through which the ligature is passed after having been brought round the artery below, and the pressure is made to the necessary extent by turning the screw, which tightens the ligature.

In the year 1810 Percy invented a presse-artère, the mode of action of which was different from either of the former; by it the compression was made upon the artery laterally, and no ligature was required. This instrument consisted of two flat plates connected together as in the dissecting forceps, between which the artery was compressed, which was effected by a double-headed button, running in a longitudinal cleft in each branch; and there was a scale upon the back of one of the plates which showed when the necessary degree of pressure had been made. A forceps on this principle is found at the surgical instrument-makers, which is employed sometimes for the torsion of small arteries.

In the same year M. Duret, in a thesis upon "the immediate compression of the artery in the operation for aneurism," gave a description and figure of a presse-artère constructed nearly upon the same principle as that of Percy, but not possessing any material advantage over it. Neither of the three last instruments described appear to have been used in operations for aneurism. In the same year (1810) Dubois employed an instrument for the immediate compression of the artery, termed a serre-nœud; this is similar to the instrument used by Dessault for the ligature of polypi, which is figured in the second volume of his works. Dubois tried this on a patient in the Hôpital de l'Ecole de Médecine, who had an aneurism in each ham. One only was operated on, secondary hæmorrhage occurred on the 18th day, the limb was amputated, and the patient died.

In the year 1812, Assalini, in his Manuale di Chirurgia, described another form of presse-artère which he had

used with success in three cases of popliteal aneurism. The principle of this instrument is nearly similar to that of Percy already described; it consisted of two flat blades connected together, as in the dressing forceps; a spring is attached to the upper end of one blade, which, by pressing against the other, retains their flat surfaces in contact; a greater degree of pressure can be made by a screw which passes through the handles. A modification of this instrument, known as Assalini's forceps, is commonly employed now in various operations. In the first case in which he used it, it was removed at the end of sixty hours, and in fourteen days the wound was healed. In two other cases it was removed at the end of twenty-four hours, the pulsation of the aneurism did not return, and the patients recovered in a comparatively short time.

Sir Philip Crampton in this country was the first to adopt this method of operating. In the seventh volume of the Medico-Chirurgical Transactions, published in the year 1816, he has figured and described a presse-artère which he used with success in two cases of popliteal aneurism. The mode of action of this instrument is similar to that of Deschamps, but it is provided with a screw at the top, by which the ligature is secured when drawn to the requisite tightness. In the same communication Sir P. Crampton has detailed some experiments which he made upon animals with a view to determine the effects of immediate compression. He found, when his presse-artère was applied to the carotid artery of a sheep, and the ligature drawn no tighter than was sufficient to bring the internal surfaces of the artery into contact, and retained for twenty-six hours, that the canal of the artery was so completely obstructed at the part as to be impervious to water.

The first case in which Sir P. Crampton employed this instrument occurred in the year 1814, and the following extract will illustrate the *modus operandi* of his presse-

artère. "The femoral artery was laid bare in the usual situation by an incision not exceeding three inches in length, a tape one-eighth of an inch in breadth was then passed under it. The ends of the ligature were brought through the holes in the foot of the instrument, and then crossed through the hole in its stalk. The artery was gently compressed by drawing the two ends of the ligature in an opposite direction, until the pulsation in the aneurism had ceased. The ligature was then secured by passing a small peg of wood through the hole in its stalk. In forty-four hours the ligature was completely relaxed, and there was no pulsation in the ham; on the next day the instrument and ligature were withdrawn, and by the fourteenth day the patient was able to be up. In a second case, the ligature was completely loosened in twenty-four hours after the operation, and no pulsation was detected in the aneurism. The instrument was withdrawn on the following day, and the patient made a rapid recovery, the wound being completely healed in less than three weeks.

In the Memoires de la Société Médicale d'Emulation for the year 1817, M. Ristelhueber of Strasbourg, has figured and described a presse-artère of his invention, which appears to be intended to unite the advantages of Percy's forceps with the serre-artère of Deschamps; for while it makes lateral pressure upon the vessel, it also compresses it from below upwards by means of a flat ligature. I am not aware of this instrument having been ever used.

In the year 1830, Sir Philip Crampton invented and employed with success an instrument of an entirely different construction from any of those mentioned. This consisted of a hollow splint, into which the nates and upper part of the thigh fitted, a band of steel passed from one side to the other in an oblique direction, in which was a slide with which a screw and pad were connected. The pad was applied directly upon the denuded artery, as it

passes over the ramus of the pubis, and compression made by turning the screw, by which the artery was pressed against the bone. This instrument, slightly modified, was one of the first used for *mediate* compression since the revival of this method. The case in which this instrument was used is recorded in the last number of the *Dublin Journal*.

The patient, a soldier, aged 36, was admitted into the Royal Military Infirmary in the autumn of 1830, labouring under aneurism of the femoral artery in the upper third of the thigh. As he appeared to be also the subject of thoracic aneurism, ligature of the external iliac artery was out of the question, and Sir P. Crampton "determined to try if the coagulation of the blood in the aneurismal sac could be effected by compressing the femoral artery at the point where it passes over the pubis." The vessel was accordingly exposed here to the extent of about half an inch, and the pad of the instrument applied on it, with the effect of stopping the pulsation in the aneurism and diminishing its bulk; the pulsation soon returned, but was easily commanded, and the pressure was increased or relaxed according to the pain it occasioned. "In this way the current of blood through the aneurismal sac was occasionally arrested completely, and at all times was materially obstructed. At the expiration of forty hours, the pain from the pressure became so severe that it was thought advisable to remove the apparatus, and to substitute a firm linen compress, which was secured by means of a tightly applied spica bandage; this degree of pressure was attended with no pain, but it did not completely suppress the pulsation. The bandage was tightened from time to time, and from day to day the pulsation became less distinct." In six days after the operation all pulsation in the aneurism had ceased, and the tumour was diminished one-half. In a week more the bandage and

compress were removed. Everything was proceeding most favourably, when, on the fifteenth or sixteenth day, the thoracic aneurism burst into the trachea.

"On examination it was found that the femoral artery was pervious as far as the sac, which was filled with a soft coagulum of an intensely dark colour generally, but of a bright arterial colour towards the centre, and here the coagulum seemed to be of very recent formation; a portion of it, about half an inch in length, passed into the lower or distal part of the artery."

COMPRESSION OF THE ARTERY AT THE DISTAL SIDE OF THE ANEURISMAL SAC.

Another mode of employing compression which was occasionally adopted during the period we have been considering will now require a few observations. I allude to compression upon the distal side of the sac. When an aneurism was seated too near the trunk to admit of ligature upon the artery leading to it, it was proposed to apply it to the distal or capillary side of the aneurism, because it was known that after the application of a ligature, the vessel was generally obliterated as high as the next collateral branch, and it was supposed that the same result would follow if a ligature were placed below the sac. The idea of operating according to this mode originated with Brasdor, it was put in practice by Deschamps, but it was in a great measure revived by Wardrop, who laid down the correct theory upon which it effects a cure, and who has given cases proving its efficacy and safety.

The view upon which the ligature was applied here led to the proposal of employing the pressure upon the distal side of the aneurism in cases where it was impossible to compress the artery above the sac; but in the few trials which have been made, it has been found rather to aggra-

vate the symptoms, to cause the blood to be transmitted with greater force to the sac, in consequence of which the size of the aneurism increased, and its progress became more rapid. Vernet records a case in which he employed compression according to this method; it was one of inguinal aneurism, but the pulsation increased so much, and the inconvenience became so great, that it had to be abandoned. I gave this method a trial for a short time in a case of secondary iliac aneurism where compression could not be applied above the sac, where it was probable the blood entered the sac in a retrograde course through the distal end of the vessel, and where an operation was of course out of the question. A cure was afterwards effected by direct pressure upon the sac, and as the case possesses some interest, being a well-marked example of secondary aneurism, I shall relate it here.

The patient, a brush-maker, aged 33, who had previously been the subject of aneurism of the external iliac artery, upon whom I had operated in August, 1842, and who had been discharged cured in the month of October in the same year, (the aneurismal sac having suppurated subsequent to the application of the ligature,) presented himself at St. Vincent's Hospital on the 3rd of April, 1843, and stated that a tumour had appeared three days previously in the right iliac region in the site of the former aneurism.

On examination, a tumour of considerable size, as large in fact as the former aneurism, was seen in the inguinal region of the right side, which gave a heaving impulse and appeared to expand during the systole of the ventricle when the hand was placed upon it; it was tense and painful on pressure, and the integuments over it were discoloured. By pressure the greater part of its contents could be squeezed out, and the cavity nearly emptied, but it filled soon again as if by a jet from an artery.

The patient was bled, placed in the recumbent posture, ordered a combination of tartar emetic and digitalis, and put upon low diet. This treatment was continued until the 11th of May; the tumour had not increased, but no other alteration had taken place.

May 11th. Pressure upon the distal side of the tumour, by means of Sir P. Crampton's apparatus for compressing the femoral artery, was commenced to-day; the pad was placed immediately below the tumour in the groin. The patient bore the pressure well, but it appeared rather to increase the pulsation of the aneurism.

12th. The compression has been continued at intervals, but if anything the pulsation is stronger. The pad of the instrument was now placed upon the femoral artery in the situation of the coming off of the profunda.

15th. During the last three days compression has been kept up pretty steadily, but it is discontinued at night for some hours; the tumour is evidently smaller, and its pulsation has diminished, particularly above and laterally. After a few days' further trial the pulsation became again stronger, the apparatus was consequently removed, and the patient allowed to rest.

Some days subsequently pressure was applied directly upon the aneurismal sac by means of a large compress and bandage bound tightly round the body. After this had been persevered in for a short time the tumour was found to have diminished, and it had become flatter upon the surface.

27th. On removing the bandage and compress to-day little external swelling was to be seen, the pulsation has also much diminished. Below the pulsation is more evident, but only in the line of the vessel as it passes under Poupart's ligament.

June 26th. The patient has continued the pressure. No pulsation can now be detected in the site of the tumour on the most careful examination, nor is there any external

swelling; on pressure we feel the remains of the sac, which is much shrunk, is hard and solid to the touch.

July 20th. The patient has discontinued the pressure now for upwards of a fortnight, but he has been kept as much as possible in the recumbent posture. Some remains of the tumour can still be detected by pressure over its site, but no pulsation or bruit; no pulsation is felt in the femoral artery from Poupart's ligament downwards.

The patient was dismissed shortly afterwards, and was in good health two years subsequently, when he was last heard of.

CHAPTER V.

History of compression in aneurism, continued—Cases of popliteal and femoral aneurism successfully treated by compression from the year 1826 down to the present day—Unsuccessful case recorded during the same period.

From the year 1826 down to 1843, the number of cases of popliteal or of femoral aneurism in which compression was employed, appears to have been less than at any of the other periods that we have considered. This may in some measure be accounted for by the increased confidence reposed by surgeons in the ligature, and their consequent disinclination to have recourse to a measure which had failed more frequently than succeeded, and was regarded as more than doubtful in its results. Perhaps the *eclat* to be gained by the successful performance of a capital operation was not without its influence in inducing surgeons to give the preference to a mode of treating aneurism, which afforded the opportunity for this display, over the quieter and less imposing proceeding by compression; particularly as the former had received the sanction of long experience, and was supposed to be the only certain method of curing aneurism.

In the first number of the *Provincial Medical Gazette*, published in the year 1829, a case of femoral aneurism is reported from the Winchester County Hospital, in which comparatively moderate pressure was followed by a cure. The patient two years previously had laboured under popliteal aneurism, for which the artery had been tied; an aneurism subsequently formed in the femoral artery of the opposite limb, which gradually increased in size

until it measured four or five inches in circumference. The tumour was seated in the lower third of the thigh, and was entirely removed by pressure on the artery above it. The patient could not come into hospital at the time, a flannel roller was therefore directed to be applied, which relieved the pain so much that the patient increased the pressure by tying a handkerchief tightly round the limb, the knot being placed directly over the aneurism. After a time the aneurism diminished in size, and ceased to pulsate; pressure was then made by means of a tourniquet and splint, and in a very short time the swelling subsided, and the patient recovered the use of his limb.

In Mr. Guthrie's work upon Aneurism, published in 1830, a case of popliteal aneurism in a female is mentioned in which compression was employed by his colleague, Mr. White, at the Westminster Hospital. The compression was made by means of "a newly-invented spring supposed to possess peculiar advantages." "The woman (he says) bore the pain heroically for five days, but the parts compressed sloughed deeply. The cure was completed, but the pain, danger, and risk incurred, were infinitely greater than any which could have been sustained from the usual operation."

In the second volume of the *Lancet* for 1831–32, a case of popliteal aneurism in which compression was employed is shortly given, which was under the care of Mr. Lynn in the Westminster Hospital. The pressure was made by bandages to the entire limb and a tourniquet. The result of the case is not given, but at a meeting of the Medical Society of London, held in March, 1846, in the course of a debate upon the treatment of aneurism by compression, Mr. Hancock referred to it as having been a successful case.

In the 21st volume of the Bulletin de Férusac, a case of popliteal aneurism, in which M. Cumano employed com-

pression with success, is mentioned. The patient was a male, aged 46, the pressure was applied at first to the artery in the lower third of the thigh, but the pain it occasioned obliged him to move it higher up the limb. The treatment was continued for nine days, and at the end of this period all pulsation had ceased in the aneurism.

During this period, we read of a few cases also in which what is termed a spontaneous cure of aneurism took place—that is, where previous to an operation being performed, or where the case was considered to be unfavourable for operation, a bandage moderately tight had been placed round the limb, with or without a compress upon the tumour, (though without the intention or expectation of producing any effect upon the aneurism,) and where after a time pulsation ceased, and the disease was perfectly cured. Cases of this kind have been hitherto looked upon as purely accidental, such as might occur once or twice in a practitioner's life, but from which no deduction could be drawn; and writers upon aneurism have been content to record them, and to confess their inability to explain the cause of the cessation of pulsation. I shall afterwards have occasion to allude to these cases, and I think I shall be enabled to prove that there was nothing accidental in the mode in which a cure was brought about; and that the cause of the cessation of pulsation in the aneurismal tumour admits of a ready explanation.

From the year 1843, the cases of aneurism of the popliteal and femoral arteries in which compression was employed with success, become very numerous. I shall therefore now give an abstract of each case that has been reported down to the present day, and afterwards describe the instruments which were used for making the pressure.

Case 1.—Patient, a labourer, aged 30, healthy, but rather intemperate, admitted into the Richmond Surgical Hospital, under Mr. Hutton, October 3, 1842, labouring

under popliteal aneurism upon the right side. Had been subject to cramp in the limb for the last year; tumour observed ten days previously, was then about the size of a hen's egg; it subsequently increased; no cause assigned for it. The aneurism occupies the lower part of the popliteal space; the leg is a little swollen, and the veins are turgid; the patient complains of a prickling sensation in the affected limb; on compressing the femoral artery the tumour admits of considerable collapse.

"The operation of tying the femoral artery being proposed, the patient declined to submit." A roller with a compress upon the tumour was applied and maintained for three or four weeks, but the tumour increased notwithstanding. Compression was commenced November 1st; the pressure was made first upon the artery in the middle third of thigh, subsequently upon the vessel as it passes under Poupart's ligament. The pulsation in the aneurism ceased November 28th; the tumour was solid and had decreased in size. Compression was continued until December 1st, and the patient was discharged on the 27th, the tumour in the ham not being larger than a walnut. He was seen some weeks afterwards; the tumour was then about the size of a nutmeg and extremely firm; he stated that "the limb was as strong as ever." The femoral artery pulsated naturally along the anterior part of the thigh, and an enlarged collateral vessel was felt superficially over the site of the tumour in the ham. Duration of compression twenty-eight days.—*Case contained in Dublin Journal for May*, 1843; *also in the proceedings of the Surgical Society of Ireland for April 22nd*, 1843, *published in the* Dublin Medical Press *for May 3rd, in the same year.*

Case 2.—Patient, a tanner, aged 55, not healthy, (affected with chronic bronchitis and emphysema, action of the heart feeble and irregular,) admitted into Stevens's Hospital, under Mr. Cusack, January 17th, 1843, labour-

ing under popliteal aneurism on the left side. Five weeks previously he began to experience pain from the knee to the ankle, and seven days before admission he was seized while walking with very acute pain in the ham, and on putting his hand to the part, felt a pulsating tumour. He had been in the habit of carrying heavy burdens up a ladder; no cause assigned for the disease. The aneurism is about the size of a hen's egg, and is seated low down in the popliteal space; moderate pressure upon the femoral artery empties the tumour. Not being considered a favourable case for operation, a bandage was applied to the limb, with a compress subsequently. No change having taken place, compression was commenced February 22nd, the pressure was applied to the artery in the groin, a compress being laid over the aneurism with a flannel roller to the limb, which were subsequently removed; pulsation ceased March 23rd; the tumour was then very hard, and about the size of a large walnut. Instrument removed March 25th; the femoral artery could then be traced to the tendons of the triceps and vastus internus, and an enlarged collateral vessel was felt superficial to the tumour. At the date of the last report (April 14th,) "the popliteal artery of the affected limb pulsated as strongly as that of the sound one." Duration of compression thirty-one days. —*Case reported in the Dublin Journal for May*, 1843; *also in the proceedings of the Surgical Society of Ireland for April 22nd*, 1843, *published in the* Dublin Medical Press *for May 3rd, in the same year.*

Case 3.—Patient, a servant, aged 32, healthy, admitted into St. Vincent's Hospital, under Mr. Bellingham, March 25th, 1843, labouring under popliteal aneurism upon the right side. Tumour noticed three months previously; patient's attention attracted to it by a feeling of weakness in the limb; no cause assigned for it. The aneurism seated high in the popliteal space, measures about three

inches transversely, and a little more from above downwards; the sac can be completely emptied by pressure upon the artery in the thigh; stiffness and weakness in the knee, with numbness down the calf of the leg to the ankle, complained of; there is some œdema about the ankle, and the veins of the leg are slightly varicose.

Compression commenced April 3rd; the pressure applied upon the artery as it passes over the ramus of the pubis; discontinued on the following day; reapplied April 6th; pulsation ceased on the following day, at which period the tumour is reported to have been about the size of a small orange, solid and hard. No bandage was applied to the limb. Instrument removed April 11th; the pulsation of the articular arteries about the knee was evident to the eye, and the femoral artery pulsated as low down as the tendon of the triceps. Patient discharged a month afterwards; the tumour being then very small, he had perfect use of the limb. Duration of compression two days.—*Case reported in the proceedings of the Surgical Society of Ireland for April 22nd, 1843, and published in the* Dublin Medical Press *for May 3rd, in the same year.*

Case 4.—Patient, a tinplate-worker, aged 30, healthy, admitted into University College Hospital, under Mr. Liston, July 13th, 1843, labouring under femoral aneurism upon the left side. Tumour noticed about two months previously, seated at the lower third of the thigh "in the situation where the femoral is about to pass through the adductor magnus," was increasing in size, but exact size not stated; no cause assigned for it. The patient suffered from dull pulsating pain in the tumour which prevented his sleeping. Compression commenced July 16th, a bandage having been previously placed round the limb; pressure applied to the femoral artery "at the lower part of its upper third." Pulsation ceased September 10th; great pain in the knee extending down the leg

to the ankle and foot, felt on the previous evening. Compression continued until September 16th. Patient discharged on the 24th, when scarcely any tumour was perceptible. Duration of compression fifty-six days.—*Case reported in 2nd vol. of the Lancet for* 1843.

Case 5.—Patient, a carpenter, aged 29, healthy, admitted into Jervis-street Hospital, under Mr. Harrison, May 9th, 1843, labouring under popliteal aneurism of a months' standing (side not stated, nor size of tumour); compression commenced soon afterwards, the pressure being applied to the artery as it passes over the ramus of the pubis, afterwards upon the artery about four inches below the pubis. The compression continued until the 4th of July, when the patient left the hospital. Compression afterwards continued by the patient at his own residence. Pulsation ceased August 10th. The patient eventually recovered the perfect use of his limb. Duration of compression ninety-three days.—*Case reported in proceedings of Medical Section of British Association for the year* 1843; *also in the Dublin Quarterly Journal of Medicine for August*, 1846.

In this case, as reported upon two different occasions (at an interval of three years) there is a discrepancy, which I think it necessary to notice here, although I shall have occasion again to allude to the subject when I come to describe the instruments employed for making compression. In the report of the case published at the time (August, 1843,) there is no allusion whatever to two instruments having been employed together upon the limb, although every other point connected with the apparatus used is mentioned. Whereas in the report of the case published in August, 1846, in the *Dublin Quarterly Journal*, the circumstance of two instruments having been used by the patient is put very prominently forward by the editor of that journal.

Case 6.—Patient, aged 53, business not stated, unhealthy, admitted into University College Hospital, under Mr. Liston, January 20th, 1844, labouring under femoral aneurism on the left side. Tumour observed two months previously, apparently caused by a strain in moving a cask; it had increased much in size during the last week. "It extended from a little below the middle of the thigh to near the knee, and measured sixteen inches in its greatest circumference." The patient suffered much pain in the calf of the leg and the dorsum of the foot, and there was some œdema of the limb below the knee. Compression commenced January 20th; pulsation ceased February 20th. On the 14th of March, the report states that the tumour is smaller, and the case promises very favourably; the instrument had been removed; the leg was bandaged, with a compress upon the tumour. Duration of compression thirty days.—*Case reported in the Lancet for March 23rd*, 1844.

Case 7.—Patient, a servant, aged 33, healthy, admitted into St. Vincent's Hospital, under Mr. Bellingham, June 20th, 1844, labouring under femoral aneurism upon the left side. This patient fifteen months previously had been the subject of popliteal aneurism in the opposite limb, which had been cured by compression, (see case 3.) About a month ago he began to suffer from pain in the knee like rheumatism, but the tumour was only noticed ten days since: no cause assigned for it. The aneurism is seated in the lower third of the femoral artery "engaging that part of the vessel which passes through the tendinous canal formed by the vastus internus and triceps muscle;" size from two to three inches from above downwards, and two inches transversely; pulsation very strong; the patient complains of much pain, which increases at night. Compression commenced June 27th, the pressure applied to the artery as it passes over the

ramus of the pubis; continued at intervals until August 8th; on that day a second instrument applied; pulsation ceased August 9th. Compression discontinued August 20th, at which date the tumour was very firm and solid, and about the size and shape of a small hen-egg. Patient dismissed September 10th, the limb reported to be as strong as the opposite one. Duration of compression forty-three days.—*Case reported in the* Dublin Medical Press *for August* 28*th*, 1844.

Case 8.—Patient, a baker, aged 28, healthy, admitted into Jervis-street Hospital, under Mr. Kirby, July 18th, 1844, labouring under popliteal aneurism upon the left side. Disease followed a strain three months previously; tumour size of a hen's egg, accompanied by constant dull throbbing pain. Compression commenced July 25th; a second instrument applied August 16th. September 20th, the report states that "the instruments have not been applied for several days, and the patient is permitted to walk about the ward; the limb is stiff, weak, and somewhat emaciated; a small firm nodule marks the situation of the aneurism, and an enlarged articular artery beats strongly at its inner side." Duration of compression about fifty-three days.—*Case reported in the* Dublin Medical Press *for September* 25*th*, 1844.

Case 9.—Patient, a seaman, aged 32, healthy, admitted into Haslar Hospital, under Mr. Allan, July 26th, 1844, labouring under popliteal aneurism upon the right side. The tumour was noticed three weeks previously, when it was about the size of a walnut. On admission it filled the entire ham; the sac could be emptied by pressure upon the artery above it. The patient suffered some pain in the affected limb. Compression was commenced July 27th; pulsation ceased, and the pressure was discontinued September 22nd; "a considerable sized artery was observed on the inner side of the knee shortly

before the consolidation of the aneurism. Patient discharged October 22nd; the tumour had then entirely disappeared; he was seen some time afterwards, and had remained perfectly well. Duration of compression fifty-seven days.—*Case reported in the 2nd vol. of the Lancet for* 1844.

Case 10.—Patient, a private, Coldstream Guards, æt. 27, healthy, came under Mr. Greatrex's care May 22nd, 1844, labouring under popliteal aneurism on the right side; tumour large, filling the popliteal space; no cause assigned for it. Compression commenced June 18th: pulsation ceased July 9th; pressure continued until July 18th, the tumour then hard and solid. The femoral artery could be traced to its entrance into the tendinous canal in the lower third of the thigh; enlarged collateral vessels felt about the knee, two ran downwards over the site of the tumour. Patient dismissed November 14th, and remained well subsequently; the tumour had gradually diminished. Duration of compression twenty-one days.—*Case contained in proceedings of the Royal Medico-Chirurgical Society of London for January* 14*th*, 1845.

Case 11.—Patient, a country gentleman, aged 26, healthy, came under Mr. Cusack's care October 15th, 1844, labouring under popliteal aneurism on the left side; disease traced to a fall from a horse some months previously; tumour noticed about a month since, and has rapidly increased in size. Aneurism "fills the entire of the upper part of the popliteal space, and extends as far as the inner condyle of the femur;" limb œdematous; pain very severe in tumour and in the course of the saphena nerve. Compression commenced Oct. 17th; two instruments employed, one upon the femoral artery at the lower part of Scarpa's space, the other higher up the limb. Pulsation ceased October 24th; articular arteries of the knee enlarged; a large collateral vessel runs along the inner surface of the

tumour. Moderate pressure continued until the 27th; the tumour continued to diminish in size, and the femoral artery could be traced to near the site of the aneurism. On February 14th, 1845, the report says, "no trace of the tumour can now be detected, and the use of the limb is perfectly restored. Duration of compression seven days.—*Case reported in the* DUBLIN MEDICAL PRESS *for February 26th*, 1845.

CASE 12.—Patient, a tailor, aged 29, healthy, admitted into the Meath Hospital, under Mr. Porter, December 3rd, 1844, labouring under popliteal aneurism upon the right side. A throbbing in the part observed two months previously; a tumour detected six weeks subsequently, which then had attained the size of a small orange, and was increasing rapidly; no cause assigned for the disease. On admission the tumour occupied the entire popliteal space; pressure on the artery above reduced its size about one-third; the patient suffered from pain shooting to the external ankle, particularly at night. Compression commenced December 6th; two instruments used, one applied about two inches below Poupart's ligament, the other near the tendinous canal in the triceps muscle; pulsation ceased December 30th; tumour hard and diminished in size. The patient remained well when seen in July, 1845; a small, firm, kernel-like tumour could then be felt deep in the popliteal space; limb as strong as the other. Duration of compression twenty-four days.—*Case reported in Dublin Quarterly Journal for May*, 1846.

CASE 13.—Patient, aged 30, (business not stated) unhealthy, exhibiting symptoms of disease of the heart—viz., patency of semilunar and mitral valves, with considerable hypertrophy of the left ventricle, admitted into Stevens's Hospital, under Mr. Cusack, labouring under popliteal aneurism (side not stated.) The sac was thin, its contents fluid, and easily emptied by pressure. The report,

dated April 12th, states that the patient had been admitted about a month previously; compression was commenced immediately, and continued for a short time; it was then discontinued for about ten days and resumed a fortnight previous to the date of the report; pulsation had ceased for forty-eight hours, when the patient died suddenly the day previous. Duration of compression about twenty days.—*Case detailed at a meeting of the Surgical Society of Ireland held April 12th, 1845, and reported in the* Dublin Medical Press *for April 30th, 1845.*

Case 14.—Patient, a medical man, (age not stated) healthy, came under Mr. Porter's care July 28th, 1845, labouring under popliteal aneurism, (side not mentioned); disease apparently traced to a strain nine months previously. The tumour occupied about two inches of the vessel, was soft and compressible; pressure on the artery in the groin caused the sac to appear empty; the patient suffered from stiffness in the ham.

Compression was commenced August 2nd, continued for twenty days, when the patient suffered so much from a burning sensation along the course of the tibia, that he refused to continue it, and removed to the country; there was then "a decided hardness in the seat of the disease, but the pulsation appeared nearly as great as ever." Four weeks after the discontinuance of the compression, (during a fortnight of which the patient had used much exercise,) an unusual degree of stiffness was felt in the knee, and on examination the pulsation in the aneurism was found to have ceased, and there was increased hardness in the tumour: no return of pulsation subsequently. Period which intervened between the commencement of the compression and the cure of the aneurism forty-eight days, during the last twenty-eight of which pressure was not applied.—*Case reported in Dublin Quarterly Journal for May*, 1846.

Case 15.—Patient, a labourer, aged 32, healthy, admitted into St. Vincent's Hospital, under Mr. O'Ferrall, June 23rd, 1845, labouring under popliteal aneurism upon the left side. Disease traced to a strain three weeks previously; tumour first observed three days since, stated to be large, filling the popliteal space; moderate pressure on the femoral artery renders it flaccid and empty; patient complained only of slight stiffness in the joint. Compression commenced June 25th; instrument applied about the middle of the thigh; pressure subsequently made in the groin, in addition, by means of a weight; pulsation ceased July 28th. At this period the tumour was reduced to the size of a walnut. Patient dismissed in September; a firm cord marked the site of the aneurism; the femoral artery pulsated to the lower third of the thigh, but less vigorously than on the opposite side; a small collateral vessel was felt on the surface of the original tumour; the patient could walk with tolerable ease. Duration of compression thirty-three days.—*Case reported in Dublin Hospital Gazette for October 15th*, 1845.

Case 16.—Patient, a labourer, aged 38, came under Mr. Jolley's care at the Torbay Dispensary early in July, 1844, labouring under popliteal aneurism upon the right side. Disease of about four months' standing, set in after having used much exertion in walking; when first noticed tumour was the size of a walnut, increased much subsequently; the patient suffered pain in knee, particularly at night. Compression commenced by means of a tourniquet July 23rd; pressure applied to the upper part of the thigh; pulsation ceased September 1st; a compress upon the tumour, and a bandage used in addition towards the close. At this period the tumour had diminished much in size; "no pulsation was to be felt in the artery between the aneurism and the seat of pressure." Instrument removed September 10th; the patient was seen in July, 1845, and

had remained well. Duration of compression forty days.—*Case reported in the Provincial Journal for the year* 1845.

Case 17.—Patient admitted into the Richmond Hospital, under Dr. Macdonnell, labouring under popliteal aneurism upon the right side. Disease apparently caused by lifting a heavy weight six months previously; tumour noticed shortly afterwards, but had not increased much since. Five or six years since this patient had been operated on for popliteal aneurism in the opposite limb. Compression commenced with a single instrument; pressure applied to the artery in the groin; a second instrument subsequently used, and the pressure applied to the artery lower down alternately with the other, two days after which the pulsation in the aneurism ceased. At the date of the report there had been no pulsation for two months, and "the tumour had diminished by absorption fully two-thirds its original volume."—*Case contained in the proceedings of the Surgical Society of Ireland for January* 10*th*, 1846, *and reported in the* Dublin Medical Press *for January* 21*st*, *in the same year.*

Case 18.—Patient, a private, 68th Light Infantry, aged 38, healthy, admitted into the General Hospital, Fort-Pitt, under Mr. Dartnell, July 26th, 1845, labouring under popliteal aneurism upon the left side. Tumour had suddenly formed without any apparent cause, three weeks previously. On admission the aneurism was about the size of a hen's egg, was soft, and subsided under pressure; there was some œdema about the ankle, and the patient complained of slight numbness in the leg and foot. Compression commenced August 3rd; two instruments used, one applied to the artery in the groin, the other at the lower third of the thigh; pulsation ceased on the 9th. Instruments removed on the 16th, and a bandage applied with a compress in the ham, and another over the artery. Patient discharged, and returned to light duty October

20th. Some months afterwards when examined no trace remained of the aneurismal tumour. Duration of compression seven days.—*Case reported in the Medical Gazette for March 13th*, 1846.

Case 19.—Patient, the master of a canal boat, aged 30, healthy, but of dissipated habits, came under Mr. Mackern's care December 15th, 1845, labouring under femoral aneurism on the right side. Tumour seated in the lower third of the thigh, observed first nine months since, within last three months had increased much in size; patient in his occupation obliged occasionally to lift heavy weights. Compression commenced December 29th; pressure made upon the artery immediately below Poupart's ligament; in three weeks the tumour became solid, and several collateral vessels had enlarged; pulsation ceased January 26th; "the tumour had diminished in size." Patient returned to his employment February 14th, and remained well subsequently. Duration of compression thirty-six days.—*Case reported in the Lancet for May 2nd*, 1846.

Case 20.—Patient, a tailor, aged 32, not healthy, subject to palpitation, and not very temperate, came under Mr. Stork's care September 7th, 1845, labouring under popliteal aneurism upon the left side. Patient had suffered from darting pain in the limb for seven or eight months; tumour noticed about three weeks previously; never received any injury. Aneurism about the size of a lemon; contents of sac fluid, pressure upon the artery above nearly emptying it. Compression commenced September 12th; two instruments employed, the pressure made at lower angle of Scarpa's space, and on the artery above, the limb having been previously bandaged. Bandage discontinued on the fourth day; pulsation ceased December 12th. During the last forty-four days pressure was made upon the tumour by a pad and bandage. On the 8th of April, 1846, the tumour was very firm and decreasing

in size, the patient had good use of his limb. Duration of compression ninety-one days.—*Case reported in the Lancet for May 23rd*, 1846.

Case 21.—Patient, a brewer, aged 24, suffering from skin disease, and of rather intemperate habits, came under Mr. Stork's care March 17th, 1846, labouring under popliteal aneurism upon the left side. Two months previously received an injury in the limb by his leg being jammed between casks; two days subsequently noticed the tumour in the ham. Aneurism about the size of a large egg, could be entirely emptied by pressure; whole limb œdematous. Compression commenced March 17th, two instruments used, as in the preceding case; pulsation ceased April 6th, but returned on the following day, finally ceased April 8th. At the date of the last report the tumour was the size of a walnut, and the patient was able to use the limb without inconvenience. Duration of compression twenty-two days.—*Case reported in the Lancet for May 23rd*, 1846.

Case 22.—Patient, a medical man, aged 33, healthy, and accustomed to much horse exercise, came under Mr. Cusack's care February 27th, 1846, labouring under popliteal aneurism on right side. Tumour first observed sixteen days previously, two days before which he had been seized with pain in right ham, accompanied by coldness of the limb and distension of the superficial veins. Compression commenced March 2nd, followed by numbness about the ham, œdema of the leg and foot, with pain and diminished temperature in the same part. Compression discontinued April 14th, the tumour had become more solid, was diminished in size, but pulsation could still be detected. A compress of sponge was then applied to the tumour, and retained by a bandage.

The patient returned to the country, and commenced taking exercise. In riding a spirited horse on the 22nd of

May following, he made a sudden exertion, which was followed by great pain in the knee and tumour, which increased at night. He took a full opiate which procured sleep, and on awaking the pulsation in the aneurism was found to have ceased. By the 27th of June the tumour could hardly be felt, but some pain in leg and ankle remained, with stiffness in the knee; a disagreeable numbness was also felt along the inner side of the knee, leg, and foot, "probably (the patient thinks) caused by some injury which the saphena nerve incurred during the process of applying the pressure." Compression continued for forty-three days; aneurism ceased to pulsate eighty-one days after the pressure was first used.—*Case reported in the Dublin Quarterly Journal for August*, 1846.

For the notes of the following case I am indebted to Staff-Surgeon Humfrey.

Case 23.—Patient, a private, 7th Fusiliers, aged 43, by trade a shoemaker, previously healthy, but of rather intemperate habits, admitted into the Royal Military Infirmary, Phœnix Park, July 29th, 1846, labouring under popliteal aneurism on the right side. Tumour first noticed about six weeks previously after a march of eleven miles, had felt uneasiness in the limb for some days previously, but had received no injury. Admitted into the Regimental Hospital at Newbridge under Mr. Sunter June 18th; pressure applied to the artery in groin by a weight, and to lower third of thigh by a tourniquet. Patient transferred to General Hospital July 29th.

The aneurismal tumour was then nearly as large as a goose-egg; pressure upon the artery above diminished its size, but did not completely empty it; patient complained of no pain. Compression commenced July 30th at 11 o'clock a.m. by two instruments, which were alternately relaxed, (the pressure being sufficient to check completely the pulsation); at 9 o'clock p.m. very severe pain in the

ham set in, the patient unscrewed the instrument, and found that all pulsation had ceased. Compression continued until August 2nd, the pulsation did not return, slighter pressure was then kept up until the 8th, when the instrument was removed. The aneurismal tumour now (September 24th) is about the size of a hen's egg and hard. Duration of compression ten hours; the previous pressure must, however, be taken into account, which had evidently caused deposition of fibrine in the aneurismal sac, because it could not be completely emptied by pressure upon the artery above.

The following case has not been previously reported; it has some interest, as being one of the first in which the application of galvanism was combined with compression above and below the aneurismal sac: an abstract of it only can be given here.

Case 24.—Patient, a butcher, aged 38, unhealthy, labouring under anasarca, anœmia, and enlargement of the heart, with signs of valvular disease, admitted into St. Vincent's Hospital, under Mr. Bellingham, February 10th, 1846, with popliteal aneurism upon the left side. Patient is accustomed to carry heavy loads, but never received any injury; tumour noticed about eight months previously, soon after which he entered another hospital; compression was used, but he left it about the middle of last December. The aneurism is about the size of a hen's egg; it diminishes, but does not disappear on compressing the artery in the groin; the limb is œdematous.

Compression commenced soon after the patient's admission; pressure made by a weight in the groin, and by a clamp upon the artery at the junction of the middle with the lower third of the thigh. After the compression had been continued for some time, as the pulsation continued to be strong, it was resolved to give a trial to galvanism combined with compression. By applying pressure upon

the artery above and below the aneurism, so as to retain the contents of the sac until acted on by the galvanic current, it was expected that one of the principal causes of the failure of this proceeding would be avoided; the case likewise seemed to be a favourable one, in this respect that the blood contained a very large amount of serum in proportion to the fibrine.

April 21st. A clamp was applied upon the artery above the aneurismal sac, and another below it; two acupuncture needles (insulated except at their points and hafts) were then introduced from opposite sides into the aneurismal sac, and brought into connection with a Smee's battery by Dr. Apjohn, Professor of Chemistry to the Royal College of Surgeons, who kindly afforded his services, and the galvanic current was maintained by him for about fifteen minutes at intervals. It was intended to repeat the application after a short interval, and in the meantime the patient continued the compression. In order to hasten the cure (as he thought) he had kept up very strong pressure upon the artery in the thigh for many hours, when seven days after the employment of the galvano-puncture, he was seized with a shivering, erysipelas (which was prevalent at the time) attacked the part of the thigh upon which the pad of the instrument rested, it spread upwards and downwards, and the patient died on the 4th of May, six days afterwards.

Case 25.—Another case of popliteal aneurism, in which compression was successfully employed, has been treated since in St. Vincent's Hospital, but as it has not yet been published, I am not at liberty to give the details.

Case 26.—In the following case, the compression was made upon the tumour, not upon the artery, above it.

Patient, a seaman, aged 26, admitted into the Royal Naval Hospital, Plymouth, under Mr Armstrong, October 31st, 1845, labouring under popliteal aneurism on the left

side ; health somewhat deranged ; tumour about three and a half inches in length from above downwards. Ligature of the femoral artery was resolved upon, "in preference to the less certain and more tedious method of treatment by compression ;" but an unexpected difficulty occurred, "the superficial femoral artery did not exist," although the common femoral could be traced over the brim of the pelvis, and for nearly an inch and a half below it. Accordingly direct pressure upon the sac was commenced December 4th by means of the tourniquet with two pads, one was placed immediately below the patella, the other upon the tumour ; pulsation ceased March 4th ; pressure discontinued March 20th ; "the remains of the sac were reduced to a small dense mass, not exceeding an almond in size.—*Case reported in the Lancet for July 18th*, 1846.

Case 27.—In the following case compression was employed for a time, but discontinued at the patient's request.

Patient, a drover, aged 42, healthy, admitted into the Bristol Infirmary, under Mr. Harrison, September 28th, 1843, labouring under popliteal aneurism on the left side. Tumour had been noticed some months previously ; it had attained the size of a large orange ; pressure upon the artery in the thigh caused it to diminish. Compression commenced October 3rd, the pressure applied to the artery in the groin. Treatment persevered in for a fortnight, when it was discontinued at the patient's request, and the operation performed. At this period pulsation was distinctly felt in the articular arteries about the knee, when the pulsation was arrested in the femoral artery by compressing the artery in the groin.—*Case reported in the Medical Gazette for October 3rd*, 1845.

CHAPTER VI.

Description of the instruments employed for making pressure upon the artery above the sac in the treatment of femoral and popliteal aneurism—The tourniquet truss—Mr. L'Estrange's tourniquet—Sir Philip Crampton's presse artère—The clamp—Oke's tourniquet—Messrs. Read's aneurism compress—Signorini's tourniquet—Charrière's compressor—The ring tourniquet—The weight—Mr. Carte's apparatus for applying the weight—Messrs. Read's apparatus for applying the weight—Compression by means of two instruments applied upon different parts of the limb—Mr. Millikin's double-padded compressor.

Having completed the list of cases of aneurism of the large arteries in which compression has been employed with success, and having brought the history of this method of treatment down to the present day, it remains now to describe the instruments that were used for making compression; as some of the success which has attended its recent employment, when contrasted with the results of earlier trials, may fairly be attributed to the use of more perfect instruments than were formerly in the hands of the profession.

The tourniquet truss.—The compressing instrument which, under the name of "the tourniquet truss," was employed with success by Mr. Todd and Mr. M'Coy, has been already noticed. It consists of a band nearly similar to that of a hernia truss, except that the spring is stronger, and the pad firmer. The pad is provided with an under plate, connected with the upper by a hinge, and a tourniquet screw passing through it has the effect when turned of compressing the artery with sufficient force to check its pulsation. This instrument is stated to have been used in one or two other cases where compression

succeeded, but its principal use appears to have been to compress the artery at the groin in cases of amputation near the hip-joint; it is figured by Blasius as "the inguinal tourniquet of Lafaye;" under this name it is described in some other works, and recommended as well adapted for the purpose.

Mr. L'Estrange's tourniquet.—In the year 1826 a very ingenious instrument for compressing the artery in the groin, in cases of amputation at the hip-joint, or very high up the limb, where the ordinary tourniquet cannot be applied, was invented by Mr. L'Estrange of this city. This instrument which is made of steel, forms three sides of a square, and in each side are sliding joints to allow of their being lengthened or shortened so as to fit any patient. Each extremity is provided with a pad, one of these is laid over the artery in the groin, and by turning a screw connected with it, the vessel is compressed, while counter-pressure is made upon the sacrum by the larger pad at its opposite extremity.

Mr. L'Estrange's tourniquet differs from other compressing instruments adapted to this part of the limb in the long arm of his instrument (which is in front) passing across the pubes, and pressing upon the artery on the opposite side to that which it encircles; so that, in amputation at the hip-joint, or of the thigh near the trochanters, the artery is compressed without the apparatus being in the way of the operator. This instrument has been employed at some of the Dublin hospitals in amputation, in place of the ordinary tourniquet: it has been also successfully used where secondary hæmorrhage followed the operation for popliteal aneurism. Within the last few years it has been employed in this country for making pressure upon the artery in the groin in some of the cases of aneurism already recorded, in which the treatment by compression was adopted.

Sir P. Crampton's presse artère.—In the year 1830 an instrument for the *immediate* compression of the artery in the groin was invented by Sir Philip Crampton, which, slightly modified, was employed in several of the earliest cases where mediate compression was successfully used in Dublin. This instrument consists of a hollow splint, well padded, and of sufficient size to receive the nates and upper part of the thigh of the side upon which we intend to make pressure, and sufficiently long to reach from the crest of the ileum behind to the middle of the thigh. From the upper and outer edge of the splint, a steel strap passes across to meet another from the lower and inner side: at the point where they meet the lower is fitted with a slide and the upper with a hinge; in addition, there is a sliding box, tourniquet screw and pad, with a sliding bar to prevent lateral motion. To the upper and inner edge of the splint a spring is attached which embraces the opposite side of the pelvis, and is continued into a strap which passes over the abdomen, and secures it above, while below it is secured by a soft strap which passes round the thigh. This instrument is adapted to compress the artery as it crosses the horizontal ramus of the pubis; a figure of it has been given by Dr. Fleming in the Dublin Medical Press for May 3rd, 1843; but it is seldom used now.

The clamp.—The compressing instrument known at the surgical-instrument makers here under the name of the clamp, consists of an arc of steel, having at one extremity an oblong padded splint, and at the other a nut containing a tourniquet screw connected with a smaller pad; the latter, although acted on by the screw, is so connected with it as to be readily turned in any direction. In using this instrument, the pad is laid on the artery, and the vessel is compressed by turning the screw, counter-pressure being made by the padded splint at the opposite side of the

limb. It is constructed of different sizes so as to be adapted to compress the femoral artery as it crosses the horizontal ramus of the pubis, or the brachial artery low down in the arm.

The clamp was first used as a compressing instrument in this city by a carpenter, the subject of popliteal aneurism, treated by Mr. Harrison (case 5). The pain occasioned by the apparatus originally in use induced the patient to try if the vessel could be compressed by an instrument called a clamp or cramp, which is used in his business for temporarily binding portions of wood-work until the glue intended to connect them becomes dry. It answered so well, and gave so little pain, that he continued to employ it in preference to any other until a cure was effected. The workmanship of the original instrument was, as may be supposed, rude, but it served as the model for those constructed since in this country.

At the London instrument-makers the clamp has been known under the name of Oke's tourniquet since the latter end of the year 1843. Mr. Storks of London informs me that the model of this tourniquet (which was intended for the suppression of hæmorrhage) was forwarded to Messrs. Weiss by Mr. Oke of Southampton in September of that year, and that instruments upon this principle were manufactured soon afterwards.

The clamp would, however, appear to be a much older invention; if we turn to the description of the instrument employed in the second successful case of popliteal aneurism treated by compression upon record, we shall find that it applies to the clamp now used. The case (which has been already noticed) occurred in the practice of Dubois, and was communicated to the Faculté de Médecine in March, 1810. The instrument (which is stated to have been constructed expressly for the purpose) "consisted of a semicircle of steel, both extremities of which terminated in

pads; one was provided with a screw, the other not; the pad with which the screw was connected was laid upon the femoral artery, and by turning it the vessel was compressed, the counter-pressure being made by the other pad placed upon the opposite side of the limb." There can be no doubt that Dubois' instrument served as the model for that which bears the name of "Dupuytren's compressor." In Blasius' work, published at Berlin in 1833, a compressing instrument is figured, which very closely resembles the clamp; it is termed a nerve-compressor, and is referred to Moore as the inventor.

The clamp is a cheap and effective instrument, and not the least advantages which it possesses are that its construction is so simple that it is not liable to be put out of order; the principle upon which it acts is so plain as to be readily understood by the patient; and its application can be borne for a longer time and with less inconvenience than most other instruments. A figure of the clamp will be found in Mr. Teale's retrospective address on surgery for the years 1844-45, delivered at the meeting of the Provincial Association, held in Sheffield in July, 1845, and published in the second volume (new series) of their Transactions.

Messrs. Read's aneurism compress.—This instrument, constructed by Messrs. Read, surgical instrument-makers of Parliament-street in this city, consists of a padded band which encircles the pelvis, and buckles in front, of a semicircle of steel which comes off from the back of this band, (into which it is so fitted that it can be adapted to either side) and terminates in a ball and ring, with a screw and pad attached. The ball and ring, through the former of which the screw connected with the pad passes, permits of the latter being pointed in any direction the surgeon may wish; when the pad has been brought immediately over the artery, it is fixed by turning a thumb-screw,

which causes the ring to hold firmly the ball within it. Where the ball and ring join the semicircle of steel, there is what is termed "a quadrant," which permits of their being moved either upwards or downwards, so as to vary somewhat the point of pressure, and by turning another screw they are then secured.

This instrument, which is intended for the compression of the artery as it crosses the horizontal ramus of the pubis, or of the femoral artery a little lower down, was used in several of the cases of popliteal aneurism contained in the list already given; it is a considerable improvement upon other instruments, and its application can in general be borne for a longer period than most others; as it compresses the artery in the groin, a clamp may at the same time be applied upon the vessel in the middle or lower third of the thigh. The ball and ring of this instrument have been substituted with advantage by Messrs. Read for the fixed screw in the ordinary clamp.

Signorini's tourniquet.—The instrument known under the name of the tourniquet or compressor of Signorini of Padua, scarcely differs from Dupuytren's compressor already described. It has the shape of a horse-shoe, and consists of two blades connected together in the centre by means of a screw and rack. Each extremity is provided with a pad; by turning the screw those are brought into close approximation, and the compression effected.

This instrument was employed in several of the cases of aneurism treated by compression, reported from the London hospitals, and contained in the list which I have given. A figure of it will be found in Mr. Cox's memoir upon amputation at the hip-joint; it was used to compress the artery in the groin in his operation, and is reported to have answered perfectly.

Charrière's compressor.—This is an improved instrument upon the principle of Dupuytren's compressor,

manufactured by Charrière of Paris. It consists of a semicircle of steel made in two segments which slide upon one another, which permits of the size of the arc being increased or diminished, so that the instrument can be adapted to any part of the limb. At each extremity is a joint "en charnière" which supports a pad, that which serves to compress the artery is moveable and is connected with a screw, by turning which pressure is made; a larger pad at the opposite extremity serves to make counter-pressure. This instrument (which has not been used in this country) is figured in the sixth volume of Bourgery's Médecine Opératoire.

The ring tourniquet.—This instrument consists of a flexible ring of steel about an inch in width, and of a greater diameter than the limb to which it is to be applied. At one point in its circumference is a screw connected to a pad, exactly opposite is a fixed pad, and by turning the screw these are approximated. When applied, this instrument makes pressure only upon two points—viz., upon the artery, and upon the opposite surface of the limb.

The ring tourniquet is described in few treatises on surgery, and the name of the inventor has not been mentioned. It was used by the late Mr. Tyrrell in some cases of wound of the brachial artery at the bend of the arm, which are reported in the first number of St. Thomas's Hospital Reports; the instrument was applied to the artery above the seat of the injury, with a tight bandage from the fingers to the elbow, and in all the cases a cure was effected without the formation of an aneurism. In one instance he had an opportunity of examining the condition of the parts after the patient's death from another disease; he found that the wound in the artery had completely united, and that the calibre of the vessel was perfect. In the last edition of Cooper's Surgical Dictionary this instrument is also described, and Mr.

Cooper mentions it as being adapted to cases of compound fracture complicated with hæmorrhage, and to wounds of arteries.

The ring tourniquet was used in some of the cases of aneurism treated by compression contained in the list already given; it is a light, portable, and convenient instrument, and though inferior to the clamp, might be occasionally substituted for it.

The weight.—In a case of femoral aneurism already recorded (case 7), a method of applying compression was adopted which appears never to have been previously tried, and which I found to check or to diminish the current of blood in the artery leading to the aneurismal sac with but little inconvenience to the patient. This consisted in a metal weight of from seven to nine pounds laid upon a compress or pad, placed upon the artery as it crosses the horizontal ramus of the pubis, the patient lying upon his back, with the thigh slightly flexed upon the pelvis. It was resorted to, in the first instance, in consequence of the apparatus in use having gone out of order at a time when it was impossible to have it repaired. A four-pound weight, laid upon a tourniquet pad, was first tried, but not being found sufficient, a seven-pound weight was substituted for it, which answered perfectly; in a second case it required a weight equal to eight or nine pounds to effect the same object: in both the patients preferred it to any instrument. It would therefore appear that the compressing force necessary to check the pulsation of the femoral artery in the groin is about equal to a weight of from seven to nine pounds.

The weight has the advantage over compressing instruments in its checking or diminishing the pulsation in the aneurism with little distress to the patient, as no counter-pressure is required, which is often as irksome as the direct pressure. It is not, however, applicable to every

artery, the vessel must rest upon a solid substance, against which it can be pressed, as in the lower extremity, where the artery crosses the horizontal ramus of the pubis. The disadvantages which attend this method of applying pressure are, that the weight is very easily displaced on any change in the patient's position, and its use cannot be continued when he falls asleep, as it requires the assistance of his hands to maintain it in its place. These disadvantages were endeavoured to be remedied by an apparatus invented by Mr. Carte of this city, which was imperfectly tried in a case of popliteal aneurism under my care some months since, and which I shall now describe.

Mr. Carte's apparatus for applying the weight.—This apparatus consists of three parts—viz., a belt of a peculiar shape ; a receiver in connection with it ; and metal weights of different sizes. The belt which is made of leather lined with chamois, is shaped so as to fit accurately the hip, buttock, and upper part of the thigh ; it almost surrounds the limb, and is secured on the outside by straps and buckles, one strap passing round the pelvis : immediately over the artery a circular hole is left in the belt, about an inch or a little more in diameter. The receiver (which is termed a "hopper," from its resemblance to this part in some machines) is made of very strong leather, has the shape of an inverted cone, the small end being attached to the edge of the circular hole in the belt. The weights, which are of lead and of different sizes, have a conical shape, so as to fit easily into the receiver, and are so shaped that the smaller end will pass through the opening in the belt, and rest upon a compress or pad laid upon the artery underneath.

The advantages of this apparatus are, that it is readily applied, and not easily displaced ; as the thigh belt extends over a large surface, and there is no counter-pressure, the patient will suffer little inconvenience, and the amount of

pressure can be graduated by having at hand weights of different sizes: its use may be combined with a clamp upon the artery lower down the limb.

Messrs. Read's apparatus for applying the weight.—This apparatus consists of a cradle composed of two light flat metal hoops or rings, joined together by a connecting flat piece of iron, into which the upper part of the thigh fits, and the hoops are so constructed that their size can be increased or diminished as occasion may require. A ball and ring similar to that of the "aneurism compress" comes off from the upper hoop, but instead of a screw a smooth cylindrical iron rod moves in the ball, and is connected with a pad below. The apparatus is intended for the compression of the artery in the groin, which is effected by passing flat leaden weights, having a hole in the centre, down the rod connected with the pad, and their number may be increased until the necessary degree of pressure is made.

COMPRESSION BY MEANS OF TWO INSTRUMENTS APPLIED UPON DIFFERENT PARTS OF THE LIMB, AND ALTERNATELY RELAXED.

NOTWITHSTANDING the improvements which have taken place in the construction of compressing instruments, and the ingenuity which has been displayed in the invention of new and more perfect forms, it is almost impossible in the majority of cases to adapt any apparatus to a limb, which the patient will bear for many hours consecutively, if the pressure is sufficiently strong to diminish materially the current through the main artery. This object can, however, be attained in another way—viz., by applying two compressing instruments upon separate parts of the limb, one of which is tightened, the other not; and by thus alternating the pressure, we produce the same effect as if constant

compression was maintained at one point, and the patient is enabled to keep it up for a much longer period than is possible under other circumstances.

In the report of a case of femoral aneurism, contained in the Medical Press for August 28, 1844, (case 7), I mentioned that, after having continued the compression by a single instrument for some time, I had a second constructed, which I applied upon a different part of the limb, which the patient was directed to use alternately with the other, and when the pressure became painful at one point to relax it, having previously tightened the screw of the other instrument, by which means continuous pressure was kept up with much less inconvenience to the patient. In the report of the case it is stated that twenty-four hours after the application of the second instrument the pulsation in the aneurism ceased. This mode of using the compressing instruments was adopted in many cases reported subsequently—viz., in those by Messrs. Kirby, Cusack, Porter, Macdonnell, Dartnell, Storks, and Humfrey.

In the *Dublin Quarterly Journal of Medicine* for August, 1846, a case of popliteal aneurism is reported which had been treated by Mr. Harrison three years previously (case 5), in which it is stated that this patient had, *at his own residence*, and of his own accord, employed two compressing instruments upon the limb so as to keep up continuous pressure; and the editor of that journal calls attention in several places to the important improvement introduced by this patient; although it was announced on that occasion, for the first time, that he had ever even employed this method; and the profession had been familiar with the advantages of this manner of applying the compressing instruments for two years previously.

In giving an abstract of this case, I mentioned that it had been reported upon two different occasions—viz., in the proceedings of the meeting of the British Association,

held at Cork in August, 1843, and in the *Dublin Quarterly Journal* for August, 1846, and I stated that there was a discrepancy between them ; in the first report there being no allusion to the use of two instruments, although every other point connected with the apparatus used is mentioned ; whereas in the second, it is put very prominently forward by the editor of that journal.

The following is the original report :—" The instrument at first used was that described by Dr. Bellingham in the *Dublin Medical Journal.* The pressure was made in the groin, and kept applied for about an hour at intervals, its degree being regulated by the patient himself. In the progress of the case the instrument was obliged to be changed, and one known as L'Estrange's tourniquet was applied at a different point on the limb, but this becoming irksome, a modification of the carpenter's clamp, suggested by the patient himself, was used, and continued until the aneurismal swelling subsided, and all pulsation had ceased. The collateral circulation appeared well established, and the motions of the limb were unimpaired."

The following is the second report of the same case (so far as refers to the instruments used,) published in August, 1846, three years subsequently :—

" The usual instrument then in use, consisting of a padded splint with a circular hoop, holding the stem of a pad which compressed the vessel where it passed over the ramus of the pubis, was applied May 9th. The pain experienced from this, when tightened, so as to stop the pulsation, was so great that he was unable to bear it for more than an hour at a time. The instrument was completely removed upon the 27th, and that of Mr. L'Estrange applied on the 29th, and thus the treatment was continued during the entire month of June. On the 4th of July the patient was obliged to leave the hospital.

" On his return home, having reflected upon the cause

of failure, which he naturally attributed to his having been unable to bear the pressure on the artery at the pubis, he invented, and immediately applied, a very simple instrument on the principle of the carpenter's clamp, consisting of a small well-padded iron splint, four inches by three, connected with a steel bow, in the front of which worked a screw furnished with a pad, with which he could compress the artery in any part of its course on the anterior or inner part of the thigh. He at once applied two of these, the upper compressing the vessel about three inches below Poupart's ligament, the lower about the middle of the thigh, but each of them capable of being shifted occasionally, as the point of pressure became tender. With these he completely commanded the circulation for upwards of twenty-four hours. As soon as the upper caused much pain, after an hour or so, he tightened the lower one, and relaxed that above, and so alternated from one to another, always making sure that the circulation was fully commanded by one instrument being screwed down before he loosened the other; and he had thus the satisfaction of completely effecting his own cure." The editor of the journal in question, in concluding the case, observes—"Although this man owes much to Professor Harrison, who commenced his treatment and cure, he certainly achieved for himself, personally, a great good, and for science a very valuable improvement." In two other places also he introduces the subject, and indulges in similar remarks.

Now, if the first report of this case is correct, the second must be incorrect, and *vice versa;* but as the first was the only record the profession had of it until August, 1846, and as this mode of applying the compressing instruments had been constantly used in the interval, the claims which the editor of the *Dublin Quarterly Journal* has endeavoured to found upon it can hardly be allowed.

I have been obliged to allude at greater length to this comparatively trifling matter than would otherwise have been necessary, in consequence of the prominent manner in which the subject has been introduced by the editor of that journal. I shall only add, that there is one point in connection with it which appears to be material as bearing upon the question of priority of claim, but which he has omitted to state—viz., that in a communication contained in the former series of the *Dublin Journal* for November, 1844, I mentioned, in speaking of the advantages of this mode of applying the compressing instruments, that, though I supposed it to have been *original with me* at the time, I discovered subsequently that Begin (in the article Aneurysme in the *Dict. de Med. et de Chirurg. Prat.,)* states that the same method had been employed, and had failed in the hands of Dupuytren and M. Gama of Strasbourg.

Mr. Millikin's double-padded compressor.—An ingeniously contrived apparatus, intended to supply the advantages to be derived from the use of two separate instruments, was constructed some months since by Mr. Millikin, surgical-instrument maker of Grafton-street, in this city. It had two separate pads at some distance from one another, each acted on by screws, by which separate portions of the artery could be alternately compressed. This instrument was tried in one of the cases of popliteal aneurism contained in the list which I have given, but I was informed that it did not answer as well as two separate instruments placed upon different parts of the limb.

CHAPTER VII.

Employment of chemical agents to coagulate the blood contained in an aneurismal sac—Case in which heat was employed with this object—Cases in which galvano-puncture has been used—Mode in which galvanism acts in causing the formation of a coagulum from the blood—Theory upon which galvano-puncture effects the cure of aneurism—Injection of chemical fluids into the sac of an aneurism.

In order to promote or assist the coagulation of the contents of an aneurismal sac, it has been proposed to apply to the blood contained in the sac certain chemical agents which have been found to produce this effect upon blood removed from the system. Amongst the most remarkable of these are heat and galvanism; the former has received a very partial trial; but the latter, having been recently used in combination with compression, will require more particular notice here.

Heat.—The first to suggest the application of heat for the purpose of promoting the coagulation of the contents of an aneurismal sac was Monteggia of Milan, and Sir Everard Home appears to have been the first who tried it. The details of his case are contained in the volume of the Philosophical Transactions for the year 1826; and as it appears to be little known, though presenting several points of much interest, I shall quote it here.

CASE IN WHICH HEAT WAS EMPLOYED TO COAGULATE THE BLOOD IN AN ANEURISMAL SAC.

The case was one of aneurism of the external iliac artery; the vessel had been tied upon the distal side of the sac, September 16th, 1825, but as the pulsation continued to

be strong, and the tumour continued to increase in size, Sir E. Home resolved to endeavour to coagulate the fluid blood in the sac by means of heat. Accordingly on the 28th day after the operation, "he introduced an acupuncture needle into the centre of the sac where the pulsation was most violent and the fluid state of the blood most distinctly felt; the needle was passed through a small orifice in a bar of steel, and was heated by a spirit lamp, the integuments of the thigh being guarded by means of cork. The application was continued for fifteen minutes, the patient felt heat and pain in the centre of the tumour, but not severe, and the pulsation diminished; on withdrawing the needle, the orifice was marked by a single drop of coloured serum. "In half an hour intense pain was felt in the thigh; but this was not only removed in ten minutes by twenty drops of laudanum, but the thigh and leg became more easy than they had been for the previous twelve hours, and the throbbing in the sac was reduced to an undulation."

"For two days the tumour was easy, and the pulsation had become less under the punctured part than higher up towards the belly. The tumour not diminishing, the operation was repeated on the 34th day from tying the artery; the needle and bar of steel being double the size of those before used, and the application was continued for thirty-five minutes. The internal heat was greater than before, and the pulsation in the tumour much diminished. The needle was with difficulty withdrawn, a coagulum as hard as sealing-wax, the size of a pin's head, being firmly attached to the middle of the needle. The pain the operation produced subsided in ten minutes, the internal heat continued twenty-four hours, and the tumour had now a solid feel: he was quite easy for two days, but on the third the pain and pulsation returned, also the inward pain in a still greater degree while the needle

was immersed, and the tumour was extremely tense. Under these circumstances, on the 44th day after tying the femoral artery, I repeated the application with a needle and steel double the size of those last employed: the heat felt internally was very great, but the pain was not much increased. After it had been immersed twenty minutes, the pulsation all at once stopped, and the needle was immediately withdrawn; the pain in ten minutes went off, and the patient was quite easy. From this time there was no pulsation in the tumour, which to the feel appeared solid, and therefore I considered the progress of the aneurism arrested. This was in some measure proved by the pulsation remaining violent in the external iliac artery down to the part pressed upon by the sac, but no further."

Some time subsequently gangrene attacked the foot of the affected side, which extended up the limb, and the patient sunk forty-six days after the last application of the heat. On a post-mortem examination "the coagulum in contact with the sac was found to be similar to that usually met with in large aneurismal tumours; within that there were innumerable thin firm laminæ, and the innermost portion was in the state of jelly."

Galvano-puncture.—In the year 1832, Mr. Benjamin Phillips of London, published a little work entitled—"A series of experiments performed for the purpose of showing that arteries may be obliterated without ligature, compression, or the knife," in which this was proposed to be effected by transfixing them with needles. The experiments were made upon the femoral and carotid arteries of dogs. In the appendix to this work, the author proposes to assist the action of the needles by passing a galvanic current along them. M. Pravaz upon the continent appears to have put forward the same idea; and Lisfranc, in his work on Aneurism, mentions that M. Pravaz, in conjunction with M. Guérard, performed an experiment

upon a rabbit with the object of determining the power of galvanism applied in this way; the aorta of the animal was opened, and the galvanic conductors then brought into contact with the orifice; the blood, which was escaping in jets, was checked, owing to the immediate formation of a coagulum.

CASES OF ANEURISM IN WHICH GALVANO-PUNCTURE HAS BEEN EMPLOYED.

Neither Mr. Phillips nor MM. Pravaz or Guérard appear to have ever employed this method in aneurism. The first case that I have found recorded in which an attempt was made to coagulate the contents of an aneurismal sac, by conducting a galvanic current along needles introduced into it, is contained in the Transactions of the Medical and Physical Society of Calcutta, to which it was communicated by Dr. O'Shaughnessy; it was very fully reported in the Dublin Medical Press for October 5th, 1842.

Case 1.—The aneurism was supposed to spring from the right carotid near its root, or from the innominata (but proved on a post-mortem examination to be an aneurism of the aorta). In consultation it was determined "to tie the right common carotid upon the distal side, and afterwards to promote the coagulation of the blood in it by acupuncture and galvanism, should the ligature fail to produce that effect." "The application of galvanism was suggested by Dr. W. B. O'Shaughnessy, who undertook to conduct the experiment."

Two days after the ligature of the carotid, the galvanism was applied as follows:—"The battery being arranged, two acupuncture needles, coated with asphaltum, all but at the points and near the haft, were introduced from opposite sides of the tumour into the centre of the sac, without being allowed to touch each other: to these

needles thin wires were attached which were brought in contact with the battery, so that the blood in the tumour was made to form part of the circle. Each time the circle was completed (which was repeated five times, for a second or two each time), the patient suffered a good deal of uneasiness (like thumps upon the part), and his voice became peculiarly hoarse ; on the needles being withdrawn, a drop or two of coloured serum exuded." On the following day the operation was repeated, the needles being introduced at different points. The patient died suddenly some days afterwards, and the tumour in the neck was found to be merely an offshoot from an aortic aneurism, not containing blood, but filled with an inodorous and saniès-like fluid.

At a meeting of the British Association held at Cork in August, 1843, in the debate which followed the reading of a case of popliteal aneurism treated by compression, Dr. Wm. Bevan of this city is reported to have suggested, "that the coagulation of the blood during the employment of compression might be assisted and promoted by passing slight galvanic shocks through the sac."

At a meeting of the Academy of Sciences, held October 20th, 1845, M. Petrequin, surgeon-in-chief of the Hôtel Dieu de Lyon, read a memoir "On the treatment of certain aneurisms by galvano-puncture," from which it would appear he was under the impression that he was the first to employ this method in aneurism, and that M. Pravaz alone had suggested the idea. In this memoir M. Petrequin has related two cases in which he used the galvano-puncture ; one was successful, the other not.

Case 2.—The aneurism was seated in the temporal artery, was as large as an almond, and had succeeded to an injury of the head.

"On the 10th of September I passed (M. Petrequin says) two fine steel needles into the tumour, so that they

crossed each other at right angles, I then placed them in communication with the poles of a galvanic pile. At the first contact, there was an electric shock, accompanied by sharp pain, which increased as the galvanic power was augmented, and became so severe with the fifteenth couple that the sitting was terminated. The action of the galvanism lasted from ten to twelve minutes, and the direction of the current was changed three times. During the operation the pulsations progressively diminished, and ceased entirely at the end, the aneurism being replaced by a solid tumour."

Case 3.—This was a case of traumatic aneurism at the bend of the arm: M. Petrequin used the galvano-puncture once without effect, and the patient refused to submit to a second application.

In the observations which accompany these cases, M. Petrequin observes that no means were used to retain the blood in the aneurismal sac; and he recommends in future, if the artery is of large size, that compression should be made above the sac to effect this (as suggested by Dr. Bevan), and likewise that the needles should be isolated by a coating of varnish.

In a case of popliteal aneurism which was under my care last winter, where compression had been employed for some time, I determined to give the galvano-puncture a trial, combining it with pressure upon the artery above and below the aneurism, in order to retain the blood in the sac for a sufficient length of time to be acted on by the galvanic current. I was not aware at the time of Dr. Bevan's or M. Petrequin's suggestion. An abstract of this case has already been given, but as some particulars were necessarily omitted, I shall detail them here.

Case 4.—The patient was admitted into hospital February 10th, 1846; compression was employed and continued until April 21, when the galvano-puncture was applied as follows.

The patient being laid upon his face, a compressing instrument was applied upon the artery immediately above the popliteal space, and another below it, they were then tightened, the lower one first: an acupuncture needle coated with sealing wax, except at its point and haft, was then introduced into the centre of the sac from the inner side, a very small incision with the point of the lancet having been previously made; a second was then introduced from the outer side. The needles were now brought into connection with a Smee's battery of six pair of plates by Dr. Apjohn, Professor of Chemistry to the Royal College of Surgeons in Ireland, who kindly afforded his assistance. The moment the current was completed the patient made a sudden movement of the limb which displaced the compressing instruments; he said he thought some one had struck a violent blow upon his heel; the pain diminished, but every time the current was broken he appeared to suffer increase of pain. The application was continued for about fifteen minutes at intervals; the exact period during which the galvanic current was maintained was noted at the time by Mr. Tufnell, and is as follows:—

Minutes.				Seconds.
0	...	...	...	35
0	...	...	...	55
4	...	...	...	8
5	...	...	...	20
3	...	...	...	44
14				42

But little effect was produced upon the aneurismal tumour; the patient was in a state of great alarm during its application, and he complained afterwards of a sensation of numbness in the calf of the leg and heel, which continued until the next day.

As the pulsation continued, the compressing instruments

were reapplied upon the femoral artery, but seven days afterwards, before a second application of galvano-puncture was had recourse to, the patient was attacked with erysipelas commencing in the middle of the thigh, where the pad of the compressing instrument rested, and his constitution being bad, he sunk, thirteen days after the operation.

On a post-mortem examination it was found that, notwithstanding every care had been taken to avoid it, by introducing the needles upon the inner and outer side of the sac, a portion of the sciatic nerve had been pierced by one acupuncture needle, which accounted for the severe pain in the heel experienced by the patient, and for the numbness which continued afterwards.

Although there was no record at the time of any example in which galvano-puncture had been combined with compression, it appears from a case communicated by M. Ciniselli to M. Petrequin, and reported in the *Revue Medicale* for April, 1846, that this method had been adopted by him three months previously, the only difference being that the pressure was applied merely upon the cardiac side of the aneurism. An abstract of this case appeared in the Dublin Medical Press for June 24th of the same year.

Case 5.—The aneurism was seated in the ham. On the 22nd of January, 1846, the treatment was commenced as follows:—"The patient was laid on his right side, and a tourniquet was put on the thigh high up. Four very fine steel needles, fifty-six millimetres long, were introduced into the aneurismal tumour near to each other. Two of the needles were introduced on the inner side, taking care to avoid the trunk and branches of the saphena vein, and their direction was from above downwards; the two other needles were introduced on the outer side, also from above downwards, in such a way as that the needles of opposite

sides should cross each other within the tumour without touching each other. This done, the tourniquet was tightened on the femoral artery, merely to the extent of stopping the pulsation in the tumour and artery without affecting its size or tension; a pile made on the instant composed of twenty-one pair of plates, ninety-three millimetres square, connected by bits of cloth steeped in a solution of common salt, was then applied by means of a couple of slender silver wires held in the naked fingers, and the electric current was soon in action; but as it was found very weak, the number of plates was increased after three minutes to thirty pairs, the action of which was continued for twenty-five minutes. A single needle only was touched with each pole of the battery at a time, but every two or three minutes the contact was changed to another, so that each needle received the current in succession, and of course passed in every direction. Each new contact of the wires with the needles produced a smarting in the tumour, then contraction of the muscles of the calf, and a kind of shock in the sole of the foot. To remedy these unpleasant effects the needles were raised, and while the compression on the femoral artery continued to prevent pulsation in the tumour, the latter was enveloped with a bladder of ice; the compression was then taken off the vessel, and the ice continued for six hours, at which time the pulsation in the tumour was as before the proceeding had been commenced."

At noon on the 23rd (twenty-four hours after the galvano-puncture) there was no longer any throbbing in the tumour; the patient got out of bed, and walked some steps, but continued to feel a slight stiffness in the leg. The following days the tumour gradually diminished in size, and became more firm, the lateral depressions at the knee showed, the stiffness of the joint disappeared, the leg could be completely extended, the motion in walking

became free, and there only remained a slight sensation of weight in the foot."

In the *Revue Medicale* for August, 1846, M. Petrequin has related another case in which the galvano-puncture was successfully employed by him; the aneurism was seated at the bend of the arm.

Case 6.—The patient was admitted into the Hôtel Dieu de Lyon, May 8th, 1846. He had been bled four months previously, the artery had been punctured, and an aneurism formed at the part which had attained the size of a hen's egg. The patient at the same time laboured under hypertrophy of the heart. On the 5th of June the galvano-puncture was applied, four needles were introduced, which crossed one another in the sac; they were not insulated by any coating. The brachial artery was compressed by an assistant, and a very intense current was passed through the sac; the shocks were violent, and the patient required to be held. After ten minutes the density of the tumour was found to have increased, the application was continued for twenty minutes, when the pulsation was found to have ceased. A compressor was placed upon the artery, and ice was applied to the tumour. The patient appeared greatly fatigued.

"On the 8th the compressor was removed; on the 10th suppuration in the sac had set in; the small eschars which had formed where the punctures had been made became detached, and a sero-purulent liquid flowed out. After the contents of the sac had escaped, moderate compression was maintained upon it, and by the 20th the cure was complete. The patient left the hospital July 4th, having the perfect use of the limb. On examining the patient afterwards it was found that the brachial artery divided high up, so that one branch only had been injured in bleeding.

In the *Dublin Quarterly Journal of Medicine* for

November, 1846, Mr. Hamilton has related a case of carotid aneurism in which he employed the galvano-puncture.

Case 7.—The patient, aged 43, an invalided soldier of broken down constitution, was admitted into the Richmond Hospital, March 26th, 1846, labouring under carotid aneurism on the left side, in addition to other complaints. "The tumour was about the size of a hen's egg, its centre was on a level with the cricoid cartilage, the sterno-mastoid muscle was stretched over it, its pulsation was strong, there was no bruit de soufflet." Not being considered a case for operation, and compression being out of the question, the galvano-puncture was employed as follows.

May 15th. "A thin gold needle was passed into the sac on the outside until it had penetrated to about an inch, the same was done on the inside, the needles could be made to touch in the centre, and were isolated, except at the point by shell-lac. A Smee's battery of twelve zinc and silver plates was used, which was regulated by Mr. Fagan." "The action was given very gradually by, at first, only immersing the plates to two or three inches. When the whole force of the battery was used it only caused moderate pain, and produced slight contraction of the muscles." "At the end of fifteen minutes the aneurism appeared to beat with less force. After this the pulsation became evidently less, the tumour firmer and larger, and he began to complain of uneasy weighty sensations, and very severe pain, which he compared to his throat being held fast by the teeth of a dog. He said he suffered much from pain in the left side of the forehead; the sensations in the tumour were very distressing, and those in the head, from their violence, assumed rather an alarming character; but the most serious symptom was the great increase of the swelling: this seemed the chief cause of the pain and the tight feel in the throat.

"At the end of twenty-five minutes complete coagulation had taken place in the aneurism, which felt solid, and pulsation was imperceptible: for these reasons the galvanism was discontinued. The integuments round the positive needle were observed to vesicate and to turn black for the size of a spangle; on withdrawing it, there was a slight flow of blood, but none from the puncture of the negative needle.

"So far therefore as the solidifying of the blood in the aneurism, the operation had succeeded, but not without considerable grounds of uneasiness. The unpleasant feel in the head continued, with the pain over the left eyebrow; the pupil was observed to be contracted, and there was loss of sight in the left eye. He complained much of the tightness in his throat, and the tumour was three or four times larger than previous to the application of the galvanism."

After the 17th of the month pulsation returned in the tumour. The patient died of the disease for which he had been admitted on the 8th of June, a little more than three weeks after the application, and a few days before death the pulsation in the aneurism ceased.

On examination, the aneurism was found to spring from the anterior part of the common carotid; "below the aneurism the trunk of the carotid was sound, but both external and internal carotids were much reduced in size, and so much obstructed that a probe could not be passed through them into the aneurism."

"A section of the aneurism showed the contents to be solid, the centre occupied by clotted blood of the colour and consistence of black currant jelly; from a quarter to half an inch from the margin the layers were of a pale red colour, and had a fibrous arrangement, exactly resembling muscle."

In the remarks appended to this case, the writer

observes—"As far as coagulating the blood in the sac, the application of the galvanism in this case was successful, complete coagulation having been effected by it. From the proximity of the carotid artery to the heart, and the direct course of its trunk (both favouring the rapid current of the blood), as also from the very free anastomosis with the numerous branches of the corresponding artery, an aneurism in this situation is one least likely to preserve the coagulum formed by the galvanism. In the present instance, likewise, a successful result may have been prevented by the total impossibility of using sufficient pressure to obstruct the current and prevent its washing away the newly-made clot. To be completely successful, repetition of the operation would have been required; my reasons for not deeming this advisable have been already stated."

The cause of the rapid enlargement of the aneurismal tumour, the writer refers "to the galvanic influence extending beyond the sac, and coagulating the fluids in the cellular tissue around it, the coagulated matter having been afterwards absorbed."

MODE IN WHICH GALVANISM ACTS IN CAUSING THE FORMATION OF A COAGULUM FROM BLOOD.

None of the writers whose names are mentioned have described the mode in which the galvanic current, when conveyed along needles introduced into an aneurismal sac, acts in causing the formation of a coagulum from the blood; and very vague ideas appear to be entertained respecting the power of galvanism applied in this way. The following are the views taught by Dr. Apjohn, Professor of Chemistry to the Royal College of Surgeons in Ireland, in his lectures upon the subject, which I have his permission to quote.

"When the circuit of a battery of moderate strength is completed through the serum of blood removed from the body, its albumen is coagulated at the positive pole; and there can be little doubt that if the blood contained in an aneurismal sac were subjected to the same influence its serum would undergo a similar change. As to the cause of the coagulation, it appears to be due to the decomposition, or, as Mr. Farraday terms it, the *electrolysis* of the salts of the blood, and the action on the serum of the acids developed at the anode or positive pole. The coagulation of the albumen is not, therefore, a direct consequence of the galvanic current, but arises from the analytic action exercised by it upon the saline constituents of the blood.

"If the battery is very powerful, the effect upon the serum may extend throughout the entire of the space separating the poles. But even in such a case, the coagulation is not, I believe, due to any specific agency exerted by what is called the galvanic current, but to the elevated temperature produced along the line of its trajet."

The coagulum developed by the action of the galvanic current upon blood would, therefore, appear to consist of *albumen*, derived from the decomposition of its serum; such a coagulum will be necessarily loose and flocculent, and altogether different from that which forms in an aneurismal sac under ordinary circumstances.

In order that the albumen of the serum of the blood contained in an aneurismal sac may be coagulated, it would seem to be essential that the blood should be retained in it for a sufficient length of time to be acted on by the galvanic current; consequently, compression ought to be made upon the artery above and below the sac during the operation; if this precaution is not taken, the blood will pass through the sac too rapidly to permit of its decomposition.

It appears to me that a coagulum might be developed

from another source, when a galvanic current is conducted along needles introduced into an aneurismal sac: thus after the decomposition of the serum contained in the sac, and the separation of its albumen from the other constituents, it is not unreasonable to suppose that the fibrine and red globules of the same portion of blood (being then in some measure set free) might form a distinct coagulum; but of this we have no proof; and such a result could hardly be expected unless the galvanic current had been maintained for a sufficient length of time to coagulate completely the albumen of the serum contained in the sac. Even under these circumstances the coagulum would be loose and soft, and have little analogy with the fibrinous layers found in aneurisms of some standing.

THEORY UPON WHICH THE GALVANO-PUNCTURE EFFECTS THE CURE OF ANEURISM.

From what precedes, it would, therefore, appear to be improbable that a coagulum, sufficiently large to fill the sac of an aneurism, and sufficiently firm to resist the current of blood in the main artery of a limb, can be developed under any circumstances by the agency of the galvanic current; more particularly if compression upon the artery above and below the sac is not employed at the same time. How, then, it may be asked, has it happened that in some of the cases which have been recorded, the pulsation in the aneurism ceased either immediately, or soon after its application, although compression was not always used? It appears to me that there are two distinct modes in which such a result may be brought about.

According to the first, compression upon the artery above and below the sac is indispensable during the operation; when the galvanic current is completed, the albumen of the serum of the blood contained in the

aneurismal sac is gradually coagulated, and on the discontinuance of the compression, the coagulum thus formed is forced out of the sac, and carried with the blood into the artery at the distal side of the sac, the channel of which may be thus blocked up. If a distinct coagulum of the fibrine and red globules forms at the same time (in the way to which I have alluded), it will render the chances of the artery below the sac being obstructed, still more probable. It is easy to understand how a comparatively small and loose coagulum could produce this effect; and it is clear that if the artery at the distal side of an aneurismal sac were thus closed up, the pulsation of the aneurism might cease at once, or the cure of the disease would be readily accomplished by moderate pressure afterwards upon the artery at its cardiac side.

The other mode in which the galvano-puncture may cause the cessation of pulsation in an aneurism, and that, perhaps, which is the most frequent, is by exciting *inflammation* in the sac or parts about it. Inflammation would be soon followed by swelling from effusion of serum or lymph; the artery supplying the sac or leading from it would be thus compressed, and its pulsation checked or diminished according to circumstances. This result obviously may follow, whether compression has been employed or not; and it is more likely to happen when a powerful battery has been used, than one of moderate strength. That it has already occurred, is evident from the details of one of M. Petrequin's cases, in which suppuration of the sac followed the application.

If the foregoing views are correct, a galvanic battery of moderate strength is to be preferred to a more powerful one, as being less likely to occasion inflammation; and the application ought always to be combined with compression upon the artery above and below the sac.

On the whole it appears to me that much can never be

expected from galvano-puncture as an agent in the cure of aneurism: it is doubtful if the current of a battery of moderate strength, however long continued, can develop a coagulum sufficiently firm to produce even the effects I have mentioned; and the employment of a powerful battery is not without risk if the aneurismal sac is of considerable size, or springs from a large artery. In addition, it is difficult to isolate completely the shaft of the acupuncture needles; the substance used for this purpose is either detached in the act of introducing them, or it is softened when the galvanic current is completed: hence the tissues through which the needles pass are acted on, and the strength of the current is necessarily wasted. I need hardly delay here to allude to an objection urged against this measure by a writer in the *Dublin Quarterly Journal of Medicine*—viz., that erysipelas may follow the employment of the acupuncture needles, because every one, I presume, is aware that erysipelas may follow any form of puncture, wound, or incision, in any part of the body.

Injection of a chemical fluid into the sac of an aneurism.—Mr. Wardrop, in the article "Aneurism" in the Cyclopœdia of Practical Surgery, has suggested the injection of dilute acetic acid (by means of Anel's syringe,) into the sac, with the view of causing the formation of a coagulum.

"It appears to me (he observes) that the fluid blood contained within an aneurism might be coagulated with safety by injecting into the sac a proper quantity of one of those substances which produce the instantaneous coagulation of blood that has been just removed from a living animal. Of these substances, perhaps there is no one which would be better adapted for this purpose than *acetic acid*, a small quantity of which is known to coagulate a very considerable quantity of blood. Vinegar could be

very easily injected into the sac of an aneurism with Anel's syringe, a puncture having been previously made into the sac with a needle; and it might be advisable to arrest the circulation through the diseased artery previously to such an operation by an adequate compression of the vessel either on the capillary or cardiac side of the tumour. If the blood within an aneurismal sac could be thus coagulated, its curative effects might be reasonably supposed to proceed in the same manner as if the coagulation of the blood had been effected by obstructing the circulation through the vessel by the application of a ligature."

I am not aware that the foregoing suggestion of Mr. Wardrop has been ever carried into effect.

CHAPTER VIII.

Theory upon which compression was supposed to effect the cure of aneurism, from the period of the introduction of the Hunterian operation, down to the year 1843—Opinions of writers on aneurism, during that period, bearing upon this mode of treating aneurism—Opinions of Hodgson, Guthrie, Sir A. Cooper, S. Cooper, Lawrence, Colles, Gibson, Begin, Boyer, Todd, and Hunter—Theory laid down by the author in the year 1843, as to the mode in which compression acts in bringing about the cure of aneurism, and as to the amount of pressure necessary to produce this effect.

Previous to the time of Hunter, when compression was employed in the treatment of aneurism, the pressure was generally made upon the aneurismal sac, and the entire limb was at the same time bandaged. I have already stated the views upon which surgeons applied pressure at that period, and I have explained the theory upon which they supposed it to effect the cure. But as the principles upon which the Hunterian operation was based came to be generally understood, this method of employing compression was in a great measure abandoned, and the pressure was made upon the artery between the aneurism and the heart, in a situation where its coats were healthy.

Although the latter proceeding had many advantages over that which it superseded, still this mode of treating aneurism does not appear to have gained partizans; the ligature of the artery at a distance from the sac was found to be so satisfactory, and was attended with so much success, when contrasted either with the old method of operating, or with compression, that it came to be generally adopted in these countries, and a brilliant series of successful operations, in which the largest arteries in the

body were in succession tied, characterized the history of aneurism during the present century; its treatment by operation was supposed to be susceptible of little further improvement, while compression was never resorted to, except in the very early stage of the disease, when the necessity for surgical interference was not urgent; or where circumstances appeared to render the ligature unadvisable; or finally, where the patient, from timidity or other cause, refused to submit to an operation.

The success of the ligature led not only to the disuse of compression, but it appears to have led also to the adoption of very erroneous ideas respecting the mode in which it ought to be applied. Surgeons became so habituated to rely solely upon the ligature that they would not believe a cure could be effectual without the obliteration of the vessel between the aneurismal sac and the heart; and they endeavoured to accomplish by pressure what the ligature only can effect; in fact, they may be said to have shaped their theory of the mode of action of pressure, from the mode in which they found the ligature to act. The consequences were such as might have been anticipated; a mistaken theory begat an erroneous practice, compression in the few cases in which it was employed failed, and ultimately fell almost completely into disrepute.

The views upon which surgeons employed compression, during the period in question, were to endeavour to excite such a degree of inflammation in the coats of the artery at the point compressed as would cause effusion of lymph, which would be followed by adhesion between the opposite sides of the artery and obliteration of its cavity; or to excite inflammation in the tissues surrounding the artery, and between its coats, by which its tube would be so much compressed as to become impervious to the passage of blood. The latter view was advocated by Freer, and I have already detailed his experiments on the horse upon

which it is founded. Under such circumstances, a cure of aneurism, it may be supposed, was very seldom effected by compression; indeed, so seldom that the plan came to be almost entirely abandoned by surgeons, it was discountenanced in every standard work on surgery down to the year 1843, and represented to be not only tedious and painful, but doubtful and uncertain in the extreme; in proof of which I shall now make a few extracts from the works of writers, whose opinions upon a question of the kind rank the highest.

Mr. Hodgson, in his treatise on Aneurism, published in the year 1815, (a work which for many years was regarded as a standard authority upon every point connected with aneurism and its surgical treatment,) observes—

"The compression of a portion of the artery above the disease has also been recommended in the treatment of aneurisms in the extremities. The object of this practice is to place the opposite sides of the artery in a state of contact, and at the same time to excite such a degree of inflammation in its coats as shall produce their adhesion. When this is effected, the disease will be placed in the same condition as after the modern operation for aneurism, in which the cavity of the artery is obliterated at a distance from the tumour by the application of a ligature. The absorbents will remove the coagulum which is deposited in the sac, and the circulation through the limb will be carried on by collateral vessels.

"Experience proves that the pain is insupportable which is produced by screwing the instrument to that degree of tightness which is required to effect the obliteration of the artery. In the temporary application of the tourniquet during amputation, it is universally a source of great distress to the patient; from this circumstance it may be imagined what must be the protracted suffering which is necessary for the excitement of inflammation in a deep-

seated artery. * * * * In the only instance in which I have known it employed, the patient insisted upon the removal of the instrument in less than an hour after its application. The pain which was produced by continued pressure was insupportable."

Mr. Guthrie, in his work on Aneurism, published in 1830, observes—

"The application of pressure by means of a spring pad has been tried, and has sometimes, though very rarely, succeeded. The process is long, the pain great, and there is danger of the part sloughing; the pain, indeed, is so great that few persons can be persuaded to submit to it, and those surgeons who have tried it once, will not again put it in competition with the operation. Mr. White, one of my colleagues at the Westminster Hospital, tried it in a case of popliteal aneurism in a woman; she bore the pain heroically for five days, but the parts compressed sloughed deeply. The cure was completed; but the pain, danger, and risk incurred, were infinitely greater than any which could have been sustained from the usual operation. I watched the progress of the case with great attention, and will not be easily induced to use that or any other instrument for such a purpose."

Sir Astley Cooper, in his Surgical Lectures, edited by Lee, which were published in the year 1836, speaking of compression in aneurism, observes—

"Very many years ago, I had an iron ring made, with a pad on the outer side and a screw on the opposite; this was put on the limb, pressure on the outside was made against the thigh, and on the inside against the artery."—[This instrument was probably the original of the "ring tourniquet" already described.]—"The use of this was worse than the operation; I applied it on a man, and he kept it on only twenty-four hours. In three hours from its first application he began to complain of pain; in a

few hours afterwards it became worse, and in less than twenty-four hours the man said that he would submit to any operation rather than suffer the pain; therefore it is impossible to practise it. I have tried the same experiment on the upper extremity, but without its leading to any useful results. This plan of pressure on arteries does not succeed, and therefore ought to be abandoned."

Mr. Samuel Cooper, in his "First Lines of Surgery," observes—

"Although it may be generally proper to try pressure in the early stage of the disease, it cannot be said that the practice is attended with considerable success. I should suppose, indeed, that it does not answer in more than one case out of thirty, and a certain proportion of the successful instances on record are, no doubt, rather examples of a spontaneous cure. * * * * The plan has many times been attempted, and ingenious compressing instruments devised; but unfortunately the large nerve, which usually accompanies every artery of importance, must also be compressed, and the agony which the patient experiences is so great as to compel the surgeon to relinquish the project. Another common cause of failure proceeds from the artery not admitting of being efficiently compressed against a firm surface underneath it; consequently the circulation through the vessel still goes on, and the adhesive inflammation of its inner coat is not excited."

Mr. Lawrence, in his Lectures on Surgery, published in the *Medical Gazette* in the year 1830, speaking of compression in aneurism, observes—

"It has been proposed to subject the artery immediately above the aneurismal tumour to effective pressure, so as actually to place the sides in contact, and keep them so, in expectation of lymph being effused, so as to produce adhesion, and consequently obliteration of the tube. Now, this can be effectively done in the horse, but it

cannot be borne by the human subject; the pain is so excessive that it cannot be tolerated even for a short time. You might easily anticipate this result when you consider what kind of pressure is necessary in amputation in order to prevent the flow of blood through the limb. You find it necessary to screw the tourniquet tightly to prevent the blood from flowing through the artery; and you find that the pressure thus produced is so painful, if prolonged beyond a few minutes, that the patient is not able to bear it: and you can easily suppose that no individual could bear the prolonged pressure that I have alluded to, if extended to three or four days.

"Without asserting, then, that pressure has in no instance either cured or contributed to the cure of aneurism, we may say at all events, that in a vast majority of cases, it has totally failed. We may state safely that a person cannot bear the application of pressure in a degree adequate to produce closure of the artery, and consequently that this method does not deserve any confidence as a general means of treating aneurism; so that we are not surprised that it has passed into disuse. The only effectual mode then of proceeding is the surgical operation of tying the artery above the aneurism, or at the place where it opens into the swelling: this is at all events a rational mode of proceeding."

Mr. Colles, in his Lectures on Surgery, delivered at the Royal College of Surgeons in Ireland, and published in the Dublin Medical Press in the year 1844, speaking of compression in aneurism, observes—

"Pressure may cure an aneurism, but if we make the pressure on the aneurismal tumour itself, it must be extremely light, but if the pressure is made upon the *artery* going to the aneurism, the degree of compression must be directly the reverse of this. Whenever an artery is compressed so strongly as to stimulate it without the pressure being

strong enough to bring the sides of the vessel quite into contact, there will be a proportionate effort of the artery to overcome this. This was exemplified in the old practice of keeping a compress along the entire course of the artery, with the view of enlarging the anastomosing vessels, and diminishing the force of the blood going to the aneurism; the effect of this practice generally was secondary hæmorrhage. * * * * If the pressure be applied to the artery going to the tumour, it must be so strong as to cause the sides of the artery to adhere."

Mr. Gibson of Philadelphia, in his treatise on Surgery, observes—

"Compression is now rarely resorted to, experience having proved its general inefficacy. The process has been found, moreover, even when successful, so extremely painful and tedious, that few patients can be induced to submit to it, or to persevere sufficiently long to accomplish a cure. That it operates partly upon the principle of the ligature (when it does succeed) there can be no doubt; by compressing the sides of the vessel, causing the effusion of lymph, and finally, obliteration of the channel, so as to force the blood to abandon the sac, and pass off by the collateral branches."

M. Begin, in the article Aneurysme, in the *Dict. de Med. et de Chir. Pratiques*, observes—

"The cases of success which have followed the employment of compression are few compared to the number of instances in which it has been tried. The difficulties in this method are inherent in it, and can be overcome by no instrument,—no matter what precautions we employ,—no matter upon what part we apply the compression, or with what care we graduate the pressure, it soon becomes painful, and in the great majority of cases insupportable. The greatest courage and the firmest resolution are not equal to it.

"Seldom employed, and little worthy of being employed, if used with the object of curing aneurism, compression is of manifest advantage in the majority of cases as a preparatory step to the ligature; by preventing the passage of the blood through the artery, it forces this fluid to pass gradually by the collateral channels, which become dilated; it thus tends to establish the circulation, which becomes inevitable when the operation is performed."

It is unnecessary further to multiply quotations from the works of cotemporary writers; there appears to be a remarkable similarity in the opinions advanced by each respecting compression, and the manner in which it was supposed to act in the cure of aneurism. The only writer of any eminence, whose views respecting the *modus operandi* of compression are at all different, is Boyer. In the second volume of his treatise on Surgery, in speaking of compression in aneurism, he observes—

"To occasion adhesion between the opposed surfaces of the artery, the compression must not only be sufficient to prevent the passage of blood, but to cause inflammation of the arterial tunics. Such an amount of pressure would soon become insupportable, and we should be compelled to abandon it before the amount of inflammation necessary to produce such a result was obtained. It is probable that it is not by determining adhesion between the parietes of the vessel at the part, that compression acts in bringing about the cure, but by preventing the blood from arriving at the aneurismal sac with sufficient force to pass through it, and by favouring the coagulation of the blood which it contains, and thus determining the obliteration of the artery at the point where it is diseased."

In another place, in alluding to the mode in which pressure should be applied, he says, "the compression ought to act with sufficient force to prevent the passage of blood into the sac, without impeding the circulation in the limb."

The third volume of the Dublin Hospital Reports, published in 1822, contains some observations upon compression in aneurism by the late Mr. Todd, an extract from which has been recently brought forward by the editor of the *Dublin Quarterly Journal of Medicine*, from which he seeks to make it appear that Mr. Todd employed compression with the same view as it is used at the present day; consequently, that the principles upon which it is now applied are not new. Although I have already shown that the statements advanced by the editor of that journal are erroneous, yet as they have been repeated since in the same journal by anonymous writers (in the shape of reviewers,) and others, I am reluctantly obliged again to allude to the subject.

Mr Todd's communication is entitled, "A Report of Cases of Aneurism, in which Operations were performed in the Richmond Surgical Hospital." In it two cases (amongst others) are reported of popliteal aneurism, in which compression was employed for a time, and in which the operation was subsequently performed. In the preliminary remarks to these cases, (which were of course penned after the reports of the cases had been drawn up) Mr. Todd observes—

"The cases of popliteal aneurism are related chiefly with a view of recommending a more general adoption than is at present practised of a preliminary course *previously to operation*. I can scarcely doubt but that in many cases of aneurism in which operations have failed from mortification of the limbs succeeding, the patient might have been saved by a delay sufficient to allow some progress to be made in establishing the collateral circulation; and I feel confident that this desirable object may be promoted in most instances of recent disease situated at a sufficient distance from the trunk, by compressing the principal artery of the limb for a few hours every day for

a period which must vary according to the circumstances of the case."

Notwithstanding that Mr. Todd's statement of the object with which he employed compression is sufficiently explicit, yet certain contributors to the *Dublin Quarterly Journal of Medicine* still (as I have said) persist in asserting that these were not the views upon which he applied compression, and they adopt in full the erroneous statements put forward, for the first time, a few months ago by the editor of that journal. To maintain that Mr. Todd used compression with other views than those he has himself stated, argues either an extraordinary degree of prejudice on the writer's part, or supposes an unusual amount of credulity upon the reader's part; unless we regard it as the result of ignorance of the exact principles upon which compression effects the cure of aneurism. The latter being the more charitable supposition, I shall not take up further time in discussing the matter, but refer to Mr. Todd's cases, and the observations with which they are accompanied, which I have already quoted.

The extracts that have now been given contain a summary of the views entertained by the most eminent writers and teachers of the present century respecting the mode in which compression effects the cure of aneurism, and the manner in which it should be applied; at the same time they afford full evidence of the exact amount of knowledge upon these subjects possessed by surgeons, and of the degree of confidence which was reposed in this method of treatment.

In the early part of the year 1843, Mr. Hutton and Mr. Cusack each communicated a case of popliteal aneurism cured by compression to the *Dublin Journal of Medicine*, which were published in the May No. of the old series of that periodical. Mr. Cusack's case was unaccompanied

by any remarks; Mr. Hutton's concludes with the following observations:—

"Since this case occurred, Dr. Cusack has treated with success by similar means a case of popliteal aneurism in Stevens' Hospital, and Dr. Bellingham another in St. Vincent's Hospital. It would appear that this plan of treatment has been too hastily abandoned by the profession, probably from the compression employed being so excessive as to render it quite insupportable to the patient. The least possible pressure which may be sufficient to close the vessel should be used, and when this cannot be sustained, it will prove of use to partially compress the artery, so as to lessen the impulse of the circulation. In cases where the aneurismal diathesis exists, the treatment would seem to be demanded before recourse should be had to an operation."*

At a meeting of the Surgical Society of Ireland, held April 22nd, 1843, (the report of which is contained in the Dublin Medical Press for the 3rd of May in the same year,) the two foregoing cases, and a third by me, were detailed. In the observations with which Mr. Hutton concluded his case on that occasion, we find the following:

"In regulating the pressure upon the artery, care should be taken that it do not exceed the degree just necessary to obstruct the current of blood, and even when this degree of compression cannot be long maintained, it may prove of use to partially compress the artery, and thus to lessen the impulse with which the blood enters the aneurismal sac."†

The third case reported at the same meeting was, as I have said, communicated by me; the observations which accompany it are, however, too long to give here; I shall,

* Dublin Journal of Medical Science for May 1843, p. 366.

† Dublin Medical Press for May 3rd, 1843, p. 274.

therefore, merely quote the remarks I made upon that occasion bearing upon the theory on which compression effects the cure of aneurism, and on the degree of pressure necessary to bring about this result, in order that they may be contrasted with the opinions I have quoted from the writings of others upon this subject. We shall afterwards see how far the principles then laid down are correct, and how far the observations then made, have been borne out by subsequent pathological investigations.

"Surgical writers appear to have been under the impression, that in order to cure an aneurism by compressing the artery above the tumour, it was essential to interrupt completely the current of blood through the vessel—in fact, to apply such pressure as would act like a ligature, cause inflammation of the coats of the artery at the part, and obliterate the circulation in the vessel at the point to which compression had been applied.

"When it was considered absolutely necessary for the success of compression, that such an amount of pressure should be applied as was almost certain to produce sloughing of the part, and very certain to occasion intense pain and suffering; and when, in addition, this was to be prolonged through five successive nights and days, [as in the case reported by Mr. Guthrie which I had quoted,] we can readily understand why patients refused to submit to it, and we can easily account for the disrepute into which the practice fell, and for the unwillingness of surgeons to adopt this treatment, in preference to the simple operation of placing a ligature upon the femoral artery. It would, however, appear that it is not at all essential the circulation through the vessel leading to the aneurism should be completely checked, but rather the contrary: it may, perhaps, be advantageous at first, for a short period, by which the collateral circulation will be more certainly established; but the result of this case, if it does no more,

establishes the fact, that *a partial current through an aneurismal sac will lead to the deposition of fibrine in its interior, and cause it within a few hours to be filled and obstructed, so as no longer to permit of the passage of blood through it.* Pressure, so as altogether to obstruct the circulation in an artery, must necessarily be slower in curing an aneurism, as it must, in some measure, act by causing obliteration of the vessel at the part to which the pressure has been applied; whereas *a partial current through the sac enables the fibrine to be readily entangled in the parietes of the sac in the first instance, and this goes on increasing until it becomes filled;* the collateral branches having been previously enlarged, the circulation is readily carried on through them."*

That the principles laid down on that occasion respecting the mode in which compression acts in bringing about the cure of aneurism, and that the views then advanced respecting the amount of pressure necessary to produce this effect, were novel, at least to the members of the Surgical Society, would appear from the remarks the reading of the paper elicited from some of the speakers at that meeting. I may, therefore, be pardoned for quoting one or two of these observations here, particularly as they afford the best answer to the erroneous statements put forward respecting this matter, in the *Dublin Quarterly Journal of Medicine*, three years subsequently.

Doctor Benson observed, "that he considered Doctor Bellingham's communication a most important one, and his observations on the case which he brought forward of the utmost value. * * * * But he was much more gratified to find a principle established by the paper, which, in the absence of good instruments, would, nevertheless, encourage practitioners to hope for a cure, without having

* Dublin Medical Press for May 3rd, 1843, p. 277.

recourse to the formidable operation of tying the artery. It was plainly established now, that a complete interruption to the flow of blood through the artery under the instrument was not necessary; or, at all events, that a very short total interruption, aided by a partial interruption before or after, would or might suffice for the cure. The contents of the aneurismal sac, as every one knows, have a very strong tendency to coagulate, and it appears that a little help is all that is required to make that tendency effectual in curing the disease."

Dr. Beatty said—"After all, the grand point elicited is, that it is not necessary to totally obstruct the flow of blood; and it would appear that it is better not to do so for two reasons—the patient will bear the pressure needful to diminish the current, while he will not bear the amount necessary to stop it altogether. It may appear strange that slight pressure is able to cure the disease, but it is well known the method of cure adopted formerly by venesection, digitalis, rest, and starvation, acted in the same way by diminishing the current of the blood and the size of the vessels throughout the body; thus the current of blood was lessened, and the deposition of fibrine increased."*

* Report of Proceedings of the Surgical Society of Ireland for Saturday, April 22nd, 1843, published in the Dublin Medical Press for May 3rd in the same year.

CHAPTER IX.

Description of the appearances found in subjects who had been submitted to the treatment by compression, and who died either previous to, or subsequent to the cure.

When the remarks contained in the preceding chapter were published, the opportunity had not been afforded either for testing the permanency of the cures effected by compression, or of determining by pathological evidence whether the theory then advanced as to the mode in which compression acts in curing aneurism was correct or not. Since then, however, I have myself had the opportunity of examining the limb in three instances where pressure had been employed; in one, the aneurism was in progress of cure at the period of the patient's death; in the two others, death occurred at variable periods after the cure. The details of these cases afford positive evidence, not only that an aneurismal sac becomes filled and obstructed, in the exact mode which I laid down, when pressure is applied for a certain time to the vessel leading to it, but that a cure effected by compression must necessarily be permanent. In addition, a case was communicated to the Surgical Society of Ireland in the year 1845 by Mr. Cusack, where the patient died some hours after the aneurism had ceased to pulsate. I shall therefore now proceed to describe the appearance found in the dissection of the limb in these cases.

CASE IN WHICH THE PATIENT DIED PREVIOUS TO THE CESSATION OF PULSATION IN THE ANEURISM.

An abstract of this case has already been given (case 24). The patient, in addition to popliteal aneurism, laboured

under "disease of the heart, anasarca, and anœmia." Compression had been employed for several months. The pressure was applied principally at the groin, where the vessel crosses the ramus of the pubis, and in the lower third of the thigh. The patient died of erysipelas thirteen days after the employment of galvano-puncture (as already mentioned) and before the aneurism had ceased to pulsate.

On examination, I found the aneurismal sac, which was about the size of a walnut, almost filled by *firm layers of fibrine, deposited in concentric laminæ*, the layers next the sac being of a lighter colour than those near the centre; no coagulum or clot was contained in it; the opening communicating with the artery was seated at the inside of the vessel; opposite to it there remained a small empty space in the sac, in which the point of the little finger would fit; every other part of the sac was filled with solid laminated fibrine. The artery immediately above and below the aneurismal sac was healthy, and this vessel was pervious through the whole popliteal space.

CASE IN WHICH THE PATIENT DIED FORTY-EIGHT HOURS AFTER THE CESSATION OF PULSATION IN THE ANEURISM.

An abstract of this case has also been given (case 13). The patient, who laboured under "disease of heart," in addition to popliteal aneurism, was treated in Stevens' Hospital by Mr. Cusack. The compression was made chiefly upon the femoral artery near the origin of the profunda, and had been continued for about twenty days. At this period the tumour is reported to have been "completely free from pulsation, although the amount of pressure was very slight; the instruments were, however, left on until the next evening, when the patient died suddenly."

On examination, "some slight thickening of the cellular tissue surrounding the vessel, at the situation where the

pressure had been made, was observed, but no change whatever in the vessel itself. The femoral artery was pervious to within the fourth of an inch of the sac; it was here filled up by a firm coagulum which extended into the sac, and completely filled it." The sac, which was seated at the anterior part of the vessel, was considerably smaller than when the treatment had been commenced; the opening by which it communicated with the artery was large and rounded; both the anterior and posterior tibial arteries were pervious.

The preparation of the parts in the foregoing case was exhibited by Mr. Newcombe at a meeting of the Surgical Society of Ireland, held April 12, 1845.

CASE IN WHICH THE PATIENT HAD LABOURED UNDER ANEURISM IN OPPOSITE LIMBS, AND DIED SEVERAL MONTHS AFTER THEIR CURE BY COMPRESSION.

This patient had been admitted into St. Vincent's Hospital under me in March, 1843, labouring under popliteal aneurism on the right side (case 3); compression was employed, and he was dismissed cured in June of the same year. He was readmitted in June, 1844, labouring under femoral aneurism in the opposite limb, (case 7); compression was again employed, and he was discharged cured in September of the same year. In December, 1845, he was admitted for the third time, labouring under aneurism of the aorta, and died towards the end of the month, two years and a half after the cure of the popliteal aneurism, and sixteen months after the cure of the femoral aneurism.

I had the arteries of the lower extremity injected from the abdominal aorta; the injection passed freely down upon each side to the site of the original aneurismal sacs—viz., on the right side (where the popliteal aneurism had existed) to near the popliteal space; and on the left side (where

the femoral aneurism had its seat) to near the tendinous canal in the adductor magnus and vastus internus muscles.

At the site of each aneurismal sac, the artery was converted into a solid, thick, flattened band, and its channel was quite obliterated; the vein here was so firmly adherent to the artery that it could not be separated from it; indeed throughout the whole course of the femoral artery upon each side the vein was more intimately attached to the artery than in ordinary cases, so much so that had the operation by ligature been performed, it could hardly have escaped injury; thus confirming the remark made by Mr. Porter, in his work on Aneurism, that "in cases of popliteal aneurism, the femoral vein is always more closely adherent to the artery than in the healthy subject." No remains of the original sacs were to be seen, and the fibrine with which they had been filled was completely absorbed.

The femoral arteries in their course down the thigh were perfectly sound and uninjured; and there was nothing to indicate the points at which compression had been made. These vessels seemed to be rather smaller than usual, while the profunda and all the branches proceeding from it, particularly the perforating and circumflex arteries, were much enlarged; the branches which came off before the femoral artery divided were likewise increased in size. Below the site of the original aneurismal sacs the continuation of the artery was contracted on both sides; and the anterior and posterior tibial arteries in each limb were diminished in diameter near their origin.

The preparation of the parts in this case was presented at a meeting of the Surgical Society of Ireland, held January 10th, 1846, and is now in the museum of the Royal College of Surgeons in Ireland.

It will be observed that no morbid change of any kind was found in the femoral vein at the site of the pressure in

any of these cases, although from its proximity to, and close connection with, the artery in its course down the thigh, it must have shared in some measure in the compression employed. As the foregoing are the only cases in which the opportunity has been as yet afforded for making an examination of the parts after the employment of compression, I am at a loss to understand upon what grounds a writer in the *Dublin Quarterly Journal of Medicine* makes the following assertion: "In a case lately dissected, I have been assured that the vein compressed together with the artery at the apex of Scarpa's space, was found thickened for about an inch of its length. It had acquired the solidity and thickness of an artery at this place, and retained its patulous circular figure on section. Thus a local phlebitis had followed the application of the pressure at this place." Most certainly, no morbid alteration of any kind was found in the femoral vein in the cases which I examined; and if any such had been met with in the case communicated to the Surgical Society by Mr. Cusack, it is to be presumed that it would have been mentioned, because even the slight thickening of the cellular tissue about the artery which was found was noticed.

CHAPTER X.

Mode in which nature effects the cure of aneurism—Distinction between a coagulum and the fibrinous deposit found in aneurismal sacs—Proofs that compression effects the cure of aneurism in the same way as nature accomplishes this object—Proofs that the ligature of the artery at a distance from the sac effects the cure of aneurism in the same way as compression—Spontaneous cure of external aneurism.

When we consider how many writers have devoted their attention almost exclusively to the subject of aneurism, and how much talent has been engaged in illustrating its history, pathology, and treatment, it appears strange that the process which nature herself sets up for its cure should have been so much overlooked hitherto by surgeons; and although this process was daily, I may say, passing under their eyes, that the exact mode in which it was accomplished should have attracted but little attention, and no attempts should have been made to imitate or assist it.

In almost every case of aneurism where the disease has subsisted for some time, we find a larger or smaller amount of solid matter deposited in the sac, which is composed of the fibrine of the blood, arranged in regular concentric laminæ.

Examples of the spontaneous cure of aneurism, in which the sac is completely filled with fibrine deposited in regular concentric layers, are not very uncommon.

Again, in cases of valvular or other disease of the heart, when a considerable impediment exists to the circulation through its chambers, we know that the fibrine of the blood will separate from its other constituents, and form the bodies improperly termed polypi, (which are sometimes so closely interwoven with the carneæ columnæ and chordæ

tendineæ as to be with difficulty detached,) which by closing the orifices, or obstructing the action of the valves, not unfrequently prove the immediate cause of death.

These familiar facts all tend to prove—

1st. That nature herself sets up a process by which, under favourable circumstances, the cure of aneurism is effected.

2nd. That the mode in which she effects this, always in internal aneurism, and frequently in external aneurism, is by the deposition of the fibrine from the blood in the sac of the aneurism, until it becomes filled.

3rd. That the fibrine in such cases is deposited in regular concentric laminæ, the oldest or first formed next the sac, those most recently formed nearest the centre.

4th. That a current of blood through the aneurismal sac is a necessary agent in bringing about this result.

5th. That any obstruction to the current by which its velocity and amount are diminished will accelerate the deposition of fibrine in the aneurismal sac.

6th. That once this process has commenced, if the same agents continue in operation, it will go on until the sac becomes filled, and no longer permits of the entrance of blood.

Writers upon aneurism hitherto appear to have been more intent upon solving unimportant points connected with the distinction between true and false aneurism; or in ingenious speculations as to the comparative frequency of aneurism from dilatation of all the coats of the artery, or from rupture of the internal and middle coats, than in investigating the mode in which a spontaneous cure of the disease takes place. Indeed so little notice is taken of this process in some modern works, that one would suppose the authors were either ignorant of the facts just stated, or looked upon the phenomena as too unimportant to dwell upon.

Before proceeding further, there is a point upon which I

wish to make a few remarks. In the details of the cases of aneurism treated by compression which have been published within the last three years, the writers speak of the coagulation of the contents of an aneurismal sac, or of developing a coagulum in it by pressure upon the artery at the cardiac side, as if a coagulum or clot, and the concentric laminæ of fibrine which form in aneurisms, were identical: indeed, from the loose manner of expression adopted, it is sometimes difficult to tell whether the writers are aware of the distinction between them. This is the more remarkable, because the two substances in appearance, colour, and consistence, present a remarkable contrast; the one being soft and loose, of a very dark colour, not deposited in any regular order, and composed of the red globules and fibrine of the blood; the other being solid and firm, of a paler colour, deposited in regular concentric laminæ, and composed of fibrine alone, or with a very small proportion of the red globules. The former is commonly found in the auricles of the heart, and in the large veins which open into them, and is familiar to every body; the latter constitutes the solid matter, which, in greater or less quantity, fills the sac of old aneurisms.

It is obvious, therefore, that the mode in which these two different deposits are formed cannot be the same. To cause the deposition of fibrine in an aneurismal sac, it is essential that a stream of blood should pass through it for a period that will vary according to different circumstances; but its deposition will be promoted or encouraged by diminishing the strength of the current in the artery leading to it, and by lessening the amount of blood which passes through the sac. This, it is easy to understand, can be readily accomplished by compressing the artery at the cardiac side of the aneurism, and the pressure need not be so strong as to occasion very great pain to the patient.

On the other hand, to bring about the coagulation of

the contents of an aneurismal sac, the blood must remain at perfect rest for a considerable time; if a current continues to pass through the sac, the blood in it will be replaced by another portion before there is time for its coagulation; for although a coagulum or clot will quickly form when blood is removed from a vein, it is not so easy a matter to bring about its coagulation in an aneurismal sac in a living subject. To effect this, very considerable pressure would be necessary; the compression likewise, it appears to me, would require to be made upon both the cardiac and capillary side of the sac, and very near the latter; while the process will necessarily be so painful that few patients would be willing to submit to it.

It would appear then—

1st. That it is not by the formation of a coagulum in the aneurismal sac that nature effects the cure of the disease, but by the deposition of the fibrine from the blood which circulates through the sac.

2nd. That simply diminishing the current will not cause the coagulation of the contents of an aneurism, but it will occasion the deposition of fibrine in the sac.

PROOFS THAT COMPRESSION EFFECTS THE CURE OF ANEURISM IN THE SAME WAY AS NATURE ACCOMPLISHES THIS OBJECT.

The details of the cases previously given prove that pressure, so as completely to prevent the entrance of blood into an aneurismal sac (supposing that this could effect the coagulation of the blood, or that it could be borne by the patient,) is not necessary for the cure of aneurism; and all the facts connected with this method of treating aneurism go to prove that the consolidation of the tumour is brought about by the deposition of fibrine in the sac, not by the coagulation of the blood contained in it. Thus it has frequently been mentioned that at the commencement

of the treatment, the aneurismal tumour was soft and compressible, and collapsed on pressure on the artery leading to it; but after compression had been employed for a time, the sac became hard and incompressible, and did not collapse when the circulation through the artery leading to it was interrupted; proving that a deposition of fibrine had taken place, and that the process by which the sac was to be filled up had commenced.

In two cases recently published, an abstract of which has already been given, (one of which was treated by Mr. Porter, and the other by Mr. Cusack, and where the patients, curiously enough, were both medical men,) it has been mentioned that after pressure had been employed for a time, it became so irksome that the patients refused to continue it, they resumed their ordinary habits, and commenced taking exercise. At this period the sac in both cases is stated to have become hard and incompressible, yet the aneurisms ceased to pulsate, and a cure was effected, although pressure had not been used for some time; showing that the deposition of fibrine having commenced, went on, notwithstanding that compression was discontinued.

Again, I have given an account of the appearances found in the limb of a patient the subject of popliteal aneurism, who had been under treatment by compression for some time, but who died of erysipelas before the cessation of pulsation in the aneurism, and I have stated that "the aneurismal sac was in a great measure filled with firm layers of fibrine deposited in concentric laminæ," but that "no coagulum or clot was contained in the sac."

Lastly, the very fact of the irregular manner in which the compression has been maintained in many of the cases, having been often intermitted and resumed according to the sensibility or irritability of the patient, is an additional proof that it was by the deposition of fibrine in the

sac, not by the formation of a coagulum, that the cure was ultimately accomplished.*

From what I have now said, it would appear that the mode in which pressure upon the artery at the cardiac side of the aneurism effects the consolidation of an aneurism, and that by which nature effects this object, are identical; in both cases the fibrine of the blood is gradually deposited in the sac, which continues until the sac becomes filled, and no longer permits of the entrance of blood. I have next to show that the ulterior changes which take place are the same in both.

When the sac of an aneurism has been completely filled by fibrine, deposited as already mentioned, the disease is cured; it can neither increase in size, nor can rupture take place. If the aneurism was seated in the arch of the aorta, however, the calibre of the artery at the part from which it springs will still be preserved, and the circulation will continue through it as before, because the anastomosing branches are not sufficiently numerous or large here to carry on the circulation if this vessel was suddenly

* I have often been compelled, much against my will, to digress, in order to correct the misrepresentations and errors contained in a "History of the Cure of Popliteal Aneurism by Compression," put forward in the shape of an "editorial article" by Mr. Wilde, in the *Dublin Quarterly Journal of Medicine* for August, 1846 (which has been also reprinted separately, and distributed extensively). In noticing this curious production for I hope the last time, I shall merely observe, that his remarks upon the mode in which compression effects the cure of aneurism will be read with surprise by every one who has seen this method employed; and cannot fail of leading to the conclusion that the writer must be utterly ignorant respecting both its theory and practice. "It is quite apparent (he says, the italics also are his own,) that its [pressure] removal at *a particular time*, even for a few minutes, and allowing the flow of blood through the sac again to take place, will undo all that had been before effected!"—*Vide Dub. Quart. Jour. for Aug.* 1846, *p.* 131.

obliterated; while the current through it is necessarily too strong to permit of fibrine being deposited in its interior. Eventually, the sac diminishes in size from the gradual absorption of its contents, and ultimately it may in a great measure disappear.

When the sac of an external aneurism has become filled by fibrine, the disease is evidently also cured, and the circulation through the artery may continue for a time; but the anastomosing branches here being numerous and free, the blood passes down the main artery of the limb in a diminished stream, the deposition of fibrine therefore continues until the artery at the seat of the aneurism is encroached upon and gradually filled by fibrine, when its pulsation stops, and the deposition of fibrine ceases.

Once a certain amount of fibrine has been deposited in an aneurismal sac, as the result of pressure upon the artery above, there would appear to be an irresistible tendency to its continuing to be deposited until the artery at the part is likewise closed up; this fact has been proved by the two cases to which I have recently referred, where the patients refused to continue the pressure, and commenced taking exercise; yet under these apparently unfavourable circumstances, the pulsation ceased after a short interval, and a cure was effected. It is therefore not unlikely that the artery has many times been tied in aneurism, where the process which nature sets up for its cure had made considerable progress, and where a little further delay would probably have done away with the necessity for its performance.

The ultimate changes which take place when the pulsation of an external aneurism ceases, are the same, whether this result has occurred spontaneously or been brought about by compression. The circulation is carried on by the enlarged collateral vessels, the contents of the sac and of the artery at the part from which it springs, are gra-

dually removed by the absorbents, the sac disappears in a great measure, and the vessel is eventually converted into an impervious ligamentous band. Guattani, Petit, besides many other writers, have reported cases of aneurism spontaneously cured, where this condition of the parts was found; and I have already described the appearances which I found in a case where the patient died two years and a half after the cure of a popliteal aneurism by compression, and sixteen months after the cure of a femoral aneurism in the opposite limb; "the artery at the site of each aneurismal sac was converted into a solid, thick, ligamentous band, its channel was obliterated, and the contents of the sacs had been removed by the absorbents."

The foregoing facts all go to prove, that when a cure of external aneurism takes place spontaneously, or when it is brought about by compression, it cannot fail of being permanent; the sac is filled up, and the artery from which it springs is obliterated; consequently, pulsation cannot return, nor can a secondary aneurism form at the part, both of which have occasionally occurred after an apparent cure by the ligature.

PROOFS THAT THE LIGATURE AT A DISTANCE FROM THE SAC EFFECTS THE CURE OF ANEURISM IN THE SAME WAY AS COMPRESSION.

I HAVE now given a sufficient number of proofs that the mode in which compression effects the cure of aneurism, is identical with that by which nature accomplishes this object. If it could now be shown that the ligature of the artery at a distance from the sac generally effects the cure of aneurism in the same way, it might help to remove the prejudiced view taken of compression by surgeons, who are either so wedded to the ligature that they distrust every other mode of treating aneurism; or who, through ignorance of the principles upon which it effects a cure,

can see in it nothing but the revival of an obsolete and abandoned method. This I shall now endeavour to do.

Almost every writer upon aneurism mentions cases where the pulsation returned after the ligature had been used; or where hæmorrhage occurred from the sac subsequent to the operation. "It is not uncommon (Mr. Guthrie says) for a pulsation to be felt in the tumour a few hours, or in a day or two after the operation, but it very rarely continues." "A stream of blood (Mr. Hodgson observes) in most instances passes through the aneurism after the ligature of the superior part of the artery; yet this current is in most instances not sufficient, either by its quantity or by the force with which it is impelled, to continue the disease."

These facts show that the ligature of the artery at a distance from the aneurism does not always prevent a current of blood from passing through the sac, while pathology proves that inosculating branches not unfrequently communicate with the artery between the ligature and the sac; that the artery is always pervious here, and remains so after the cure of the aneurism; and that the sac has been found filled with fibrine deposited in concentric layers, where an opportunity has been afforded for examining the limb some time after the operation.

The theory laid down in modern works respecting the mode in which the ligature of the artery at a distance from the sac effects the cure of aneurism, is as follows:— When the ligature is tightened, the blood contained in the sac, or which may find its way into it afterwards, distends the sac, and extends into the artery above and below the opening by which it communicates with it; it coagulates, the fluid parts are absorbed, and the more solid, aided by the contraction of the sac, form a firm tumour. The coagulum is subsequently removed by the absorbents, and the vessel is obliterated at the seat of the aneurism, and

for a short distance above and below it. The sac gradually diminishes in size from the absorption of its contents, and ultimately disappears either wholly or partially.

The foregoing theory would be perfectly correct if the artery were always tied close to the aneurismal sac, or if the artery were always obliterated between the ligature and the sac. But as the ligature is applied at a distance from the sac, and as the vessel in nineteen cases out of twenty remains pervious afterwards for some space between the ligature and the sac, it is evident that the vessel here must have continued to convey blood after the operation, because otherwise its cavity would eventually have been obliterated. It is therefore probable that a feeble current of blood continues to pass through the sac after the operation, and that in the great majority of cases the cure is brought about by the deposition of fibrine in the sac, not by the coagulation of its contents. This is further confirmed by pathology; Mr. Hodgson says, "in the dissection of cases some time after the operation, it has been found that the cavity of the sac was filled with concentric layers of coagulum, similar to that which is met with in aneurisms undergoing spontaneous cure," which obviously could not have occurred unless a current of blood continued to pass through the sac after the operation.

The ligature of the artery at a distance from the sac cannot of course effect the cure of aneurism unless the sac itself becomes obliterated: now, it appears to me that if the theory usually laid down were correct—viz., that the blood contained in the sac, and that which finds its way into it subsequently, coagulates after the ligature is tightened, one of two results would follow the operation much more frequently—a secondary aneurism would form at the part: or suppuration of the sac would ensue.

A secondary aneurism, for instance, would be liable to form, if the sac was large, and its contents wholly fluid at

the time of the operation. It is obvious that in such a case, when the fluid portion of the coagulum is absorbed, the sac must shrink considerably to form a solid tumour. Writers upon aneurism have, however, endowed aneurismal sacs with extraordinary elastic powers, in order to enable them to uphold this theory; but in all the cases which I have seen dissected, the sac had formed adhesions with the parts in its vicinity; and if it possessed elasticity (which, considering that it is composed of the cellular coat of the artery, is rather doubtful) this agent could not have come into operation; consequently if a large anastomosing branch eventually communicated with the artery between the ligature and the sac, the pulsation would return, and a secondary aneurism would form at the part. I have little doubt that in the cases which have been reported where this result followed the operation, it was owing to a coagulum only having formed in the sac; it evidently could not have occurred if the sac was filled by fibrine deposited in the way that has been mentioned.

That suppuration of the sac would be liable to ensue under such circumstances, is, I think, also evident. We have a large sac containing more or less coagulated blood, this after a time comes to act as a foreign body, inflammation followed by suppuration sets in, particularly if, as not unfrequently happens in hospital practice, the tumour is much or often handled. The history of operative surgery contains many cases where suppuration of the sac followed the operation; and what has now been said will explain why it should have occurred in some cases and not in others apparently similar. If the ligature is placed very close to the sac, and the current of blood is thus completely cut off from it, inflammation followed by suppuration is more liable to follow than where the vessel is tied at a distance from the sac; we have seen that in the latter case a feeble current continues to pass through the

sac after the operation, the sac becomes eventually filled with fibrine, and inflammation is as unlikely to ensue as after the treatment by compression.

Writers upon aneurism are somewhat obscure as to the exact mode in which the *artery* at the seat of an aneurism is obliterated after the ligature. The examination of cases where the patient lived for a long time after the operation proved that this did occur; and that the appearances found here on dissection were exactly similar to those observed after both a spontaneous cure and a cure by compression.

The explanation usually given is, that the coagulum extends from the sac into the artery above and below it, which prevents the entrance of blood; this after a time becomes absorbed, the artery at the part gradually contracts, and is eventually converted into a solid cord. But we have seen that the artery remains pervious for some distance between the point at which the ligature is applied and the sac, and that a current of blood probably continues to pass through it after the operation, which would necessarily interfere with the formation of a coagulum in the artery at this part. Others suppose that inflammation sets in here, which unites the opposite sides of the artery; but they do not give any reason why the adhesive inflammation should be so conveniently set up at this particular spot; besides, we know that the vessel is obliterated at the same place when a spontaneous cure occurs, or where this has followed the employment of pressure, although no adhesive inflammation occurs in either of the latter cases. The explanation becomes easy, however, if we admit that a current of blood continues to pass through the sac after the operation; the obliteration of the artery will be effected exactly in the same way as occurs in cases of spontaneous cure, or where compression had been employed.

Everything that has now been said makes it probable

that the ligature of the artery at a distance from the sac, and compression of the vessel at the cardiac side, effect the cure of aneurism in the same way. It has already been shown that the mode in which nature brings about a spontaneous cure is precisely similar ; which of itself is a strong argument in favour of its correctness. But there is another circumstance which tends still further to confirm it—viz., that several phenomena connected with the surgical treatment of aneurism which were hitherto obscure, and inexplicable upon the theory that the coagulation of the contents of the sac always follows the operation by ligature, are readily explained according to this theory.

For instance, we have seen that a slight pulsation is not unfrequently felt in the sac subsequent to the operation. Now, this theory not only explains its cause, but it shows why it ceases after a short time, and why, instead of being an unfavourable sign, it should rather be regarded as a favourable one.

By this theory alone, we can account for the artery being obliterated after the ligature at the point from which the aneurism springs, while it remains pervious between the ligature and the sac.

Lastly, it enables us to explain why suppuration of the sac should occur after the operation in one case and not in others apparently similar ; and how a secondary aneurism forms in certain cases a long time after the operation, while in general it must be a rare result of the ligature.

SPONTANEOUS CURE OF EXTERNAL ANEURISM.

Every writer upon aneurism mentions or refers to cases where an external aneurism ceased to pulsate some time after admission into hospital, although a bandage had been merely placed round the limb, (with or without a compress upon the tumour,) but without the slightest intention or

expectation of producing any effect upon it. Such cases are comparatively rare, and hitherto have been looked upon as the result of some happy chance which might occur once or twice in a practitioner's life, but from which no deductions could be drawn. "Such instances of inexplicable recovery (a recent writer observes) are extremely rare, and as examples of singular good fortune, are rather to be hoped for than expected; neither can any principle of practice be established on them."

In Mr. Porter's excellent practical treatise on Aneurism, published a few years since, two cases of this kind, which occurred in the Meath Hospital, are shortly reported. "Some years since (he says) a man suffering from aneurism was admitted into the Meath Hospital. The tumour was situated low down in the popliteal space, and was large, being fully the size of a turkey's egg. The limb was semiflexed, and could not be extended; pain very considerable: tumour not compressible, at least pressure influenced its size but slightly; it was hard, and did not diminish in bulk when the femoral artery was compressed, which, however, stopped the pulsation. With a view to humour the patient, until he could be persuaded to submit to an operation which I conceived to be absolutely necessary, I rolled a bandage round the entire limb, from the toes upwards. This, as the idea of treating the disease by compression had never been contemplated, was very loose; nor had I the least notion that the tumour could have been influenced by it, one way or another. But on my visit the next day the aneurism was gone. Within an hour after the application of the bandage, the patient experienced some pain in the tumour, which soon became excruciating, and continued during the entire night. In the morning the tumour no longer pulsated—it had become solid and firm, and eventually the disease was cured."

"On another occasion a man was admitted into the same

hospital, under the care of Mr. M. Collis, with a popliteal aneurism, the history of which I do not recollect with very great accuracy, except that it was rather of large size, not compressible, and there seemed to be not much fluid blood in the sac. A bandage was applied to this in a similar manner to that in the former case ; it caused immense pain, and on the following morning the pulsation in the tumour was no longer to be felt. It, however, reappeared after a little time, but so very indistinctly that it was a questionable matter whether the sensation was not communicated from the finger of the examiner, and not from the tumour. The application of the bandage was persevered in, and in the course of a very few days no doubt could be entertained of the cure."

In the second volume of the Dublin Medical Press, Dr. Brunker of Dundalk, has related a somewhat similar case. The patient, aged 32, was admitted into the Louth Infirmary in August, 1839. His occupation had been very laborious, and the aneurism had been first observed fifteen months previously. " On examining the ham, the entire space was observed to be completely filled up by a pulsating tumour, beating synchronously with the heart, soft and compressible, but becoming distended on the removal of the pressure. Pressure being made on the femoral artery in the groin, the pulsation instantly ceased, and the size of the tumour was sensibly diminished. He was ordered to remain in bed, and was placed on low diet.

" Two days after admission, a piece of dry sponge was placed over the aneurism, and retained *in situ* by a roller rather loosely applied."

Five days subsequently, on the removal of the bandage and compress, the tumour was much diminished in size, and no pulsation whatever could be detected in it. The pressure was continued, and the patient was directed to remain in the recumbent posture. He left the infirmary a few

days afterwards. He was seen about a fortnight subsequently, the bandage and compress had been continued, and he had remained quiet. "On removing them, (Dr. Brunker observes) I could scarcely discover any traces of the former tumour, and no pulsation whatever was to be felt. A very obscure pulsation was to be felt in the anterior tibial artery, which could not before be discovered on a very careful examination."

It appears to me that the cause of the cessation of pulsation in the cases of aneurism which have been detailed, and in other similar ones, instead of being obscure, is easily explicable upon the principles laid down in the preceding pages; and that their history tends still further to corroborate what I have already said respecting the mode in which compression effects the cure of aneurism.

Thus, in every case that has been reported, the disease was of long standing, and the tumour had attained a considerable size. In the majority of cases, likewise, it was hard and solid, and did not diminish in size when the artery above was compressed; proving that a deposit of fibrine had already taken place in the sac, and that nature had already made some progress in the process by which the cure was ultimately to be accomplished. In fact, the condition of the parts was similar, in almost every respect, to that which we endeavour to bring about by the application of pressure; and which when it occurs, is the most satisfactory proof that the case is progressing towards a cure. In the third case which I have quoted, the tumour, though of long standing, is reported to have been "soft and compressible;" but it will be observed that pressure was maintained for five days before the aneurism ceased to pulsate, evidently a sufficient length of time for a deposit of fibrine to take place. Indeed in one of the cases of aneurism treated by compression, previously given, the pulsation ceased within a shorter period.

The mode in which the bandage and compress acted in effecting the cure of the aneurism in these cases appears to be similar to that in which nature, in some rare instances, has effected this object—viz., the solid, or nearly solid sac was pressed against the artery from which it sprung, or against the orifice by which the sac communicated with the artery, in consequence of which the stream of blood which entered the sac was much diminished in amount and force, the deposition of fibrine then went on rapidly until the sac and artery at the part were obstructed; when, of course, the pulsation ceased.

Although "no principle of practice could be established" upon such cases, as long as the old theory respecting the cure of aneurism continued to be entertained, yet now that it has been proved that the cessation of pulsation in an aneurism is brought about by the deposition of fibrine in the sac, not by the coagulation of its contents, they afford us a useful practical hint in the application of pressure. For instance, after compression has been kept up for a time, if the sac becomes hard to the feel, and does not increase in size on the removal of the instrument, (although it still continues to pulsate,) we may then apply local pressure to the aneurism, by means of a compress upon the sac, with every prospect of effecting a cure more quickly than if we continued to make the pressure solely upon the artery above.

CHAPTER XI.

Circumstances which may render the cure of aneurism by compression tedious or the contrary—Circumstances connected with the instruments used, the mode in which the compression is applied, or the situation at which the pressure is made—Circumstances connected with the patient, his state of health, the amount of tolerance of pressure, &c., &c.—Circumstances connected with the aneurism, its situation, size, and position with respect to the artery—Period at which the collateral circulation becomes established, phenomena which accompany it.

It may, I think, be concluded from the observations which precede, that the cure of aneurism is completed in the same way, whether brought about by nature's unaided efforts, or whether it has been assisted by art. We have seen that the sac becomes gradually filled with fibrine when an internal aneurism undergoes a spontaneous cure, and that the natural or spontaneous cure of external aneurism is generally effected in the same way. When the cure has been assisted by compression upon the artery at the cardiac side of the aneurism, the sac becomes also gradually filled with fibrine. Finally, when a ligature has been applied to the artery at a distance from the aneurism, fibrine is also deposited in the sac; and the cure, in the majority of cases, is accomplished in a similar manner.

That the deposition of fibrine in an aneurismal sac is accelerated or promoted by diminishing the force, the velocity, and the amount of the current which passes through it, we have abundant evidence; and that this is the mode in which compression upon the artery at the cardiac side of the sac acts in bringing about a cure has been sufficiently proved. It follows therefore that in the

application of compression, the degree of pressure should never be so great as to interrupt the circulation in the artery at the point compressed; although from what has been already said, as the ligature does not prevent a stream of blood from passing through the sac, it is very improbable that such an amount of pressure by an instrument from without, as could be borne for any length of time, would prevent it. Hence when surgeons have applied very strong pressure with the object of coagulating the blood in the sac, it has merely acted by favouring the deposition of fibrine in it.

CIRCUMSTANCES THAT MAY RENDER A CURE BY COMPRESSION TEDIOUS OR THE CONTRARY.

In the details of the cases of aneurism treated by compression previously given, it will be observed that the period occupied by the treatment varied very considerably; in some, a few days sufficed for a cure; in others, as many weeks elapsed before the pulsation in the aneurism ceased. It will be necessary therefore now to make a few observations under this head, and to lay down some rules for the guidance of the surgeon in its application.

Whether the treatment of aneurism by compression will be tedious, or the contrary, depends upon a variety of circumstances; and the rapidity with which a cure is accomplished may be influenced in many different ways. Some of these have reference to the instruments used, the mode in which the compression is applied, or the situation at which the pressure is made. Others rather to the patient himself, the state of his health, the condition of his blood, the degree of irritability or of susceptibility to pain, and consequently the tolerance of pressure; or his intelligence, and therefore his anxiety, to co-operate in maintaining the compression. Others have reference to the situation of the aneurism, the length of time the dis-

ease has lasted, and its condition at the period when the treatment commenced. Others, again, to the size of the sac, or of the opening by which it communicates with the artery; or finally, to the position of this opening with respect to the artery, whether it springs from the anterior, the posterior, or the lateral surfaces of the vessel.

CIRCUMSTANCES CONNECTED WITH THE INSTRUMENT, AND THE PART UPON WHICH PRESSURE IS MADE.

As the instruments used for the application of pressure have been already described, it will not be necessary to dwell much upon this part of the subject; I shall merely observe that their shape and construction appear to me to be matters of less importance than is generally imagined. A compressing instrument which will not suit in one case will be found to answer perfectly in another; and a comparatively rude instrument will be borne with little inconvenience, when one constructed upon the most scientific principles may occasion much pain.

The most essential points in an instrument for compression are, that it should admit of being readily applied; that its principle should be so simple as to be easily understood by the patient; and that it should effect the object intended with as little inconvenience as possible to the patient. With respect to the pad or compress, one which will compress nothing but the artery appears to be the most correct in theory; but in practice, a broad soft pad will generally be found to answer best. The counter-pressure which is sometimes nearly as irksome as the direct pressure, ought also to be distributed over as large a surface as possible.

The only apparatus in the use of which counter-pressure is not required, is the weight previously described, but it is only applicable to cases where the vessel rests upon a solid substance, as where the artery crosses the horizontal

ramus of the pubis ; applied here, however, it appears to occasion less pain than any instrument. The facility with which the artery at the groin is compressed varies somewhat in different cases, and the application of the weight will enable us in some measure to test this ; for instance, a weight of four or five pounds, laid upon a pad, resting upon the vessel where it crosses the ramus of the pubis, will be sufficient in one case ; while a weight of eight or nine pounds may be required in another apparently similar.

One of the most eligible sites *theoretically* for the application of pressure in popliteal or femoral aneurism, is the point at which the artery crosses the horizontal ramus of the pubis. In the earlier cases where compression was used, this was the point almost invariably selected ; and in the best constructed instruments, the pelvis has been always made the *pointe d'appui*, as in the tourniquet truss figured by Heister, and used by Mr. Todd, in L'Estrange's tourniquet, and in Read's aneurism compress. Immediately below Poupart's ligament—viz., between it and the point at which the saphena joins the femoral vein, the artery is superficially placed, and admits of being readily compressed. Although many patients bear pressure in the groin without much inconvenience, in others the lymphatic glands situated here become swollen and painful, or the limb becomes benumbed and œdematous, and we are obliged to intermit it. The majority of patients that I have seen treated preferred pressure lower down.

In applying pressure at either of the situations alluded to, the anterior crural nerve can always be avoided, because it lies to the outside of the artery, and is separated from it by the psoas muscle ; but the vein being connected to the artery by strong cellular membrane, and by the septa which pass from the fascia transversalis to the fascia iliaca between the two vessels, and upon the inner side of the

vein, (by which the distension of the sheath is prevented) *must share in the compression.* It would therefore, I presume, be rather difficult to follow the advice which a writer in the *Dublin Quarterly Journal* gives us upon this point.

"In considering the anatomy of the parts, it appears very probable that when compression is made high up, the vein may be avoided. * * * * The possibility of avoiding the vein, while compressing the artery at the groin by the finger, may be ascertained by any one who takes the trouble to make the experiment with care. I have demonstrated this repeatedly to the class, and shown the alternate interruption to the current through the artery, and the turgescence of the saphena, made at will, according as the finger was shifted from one vessel to the other. The experiment was then made with Read's instrument, and the artery compressed by placing a narrow compress of lint, with adhesive plaster, along its course at the groin, and thus guiding the pad of the screw to the proper point, without any interruption to the current through the vein."—*Dub. Quart. Jour. of Med. for Nov.* 1846, *pp.* 381-82.

Now, as this is a purely practical question, and one which can be decided by an examination of the parts, I shall merely observe, that in all the dissections which I have made, the connection between the two vessels was so close that it would have been utterly impossible to compress the artery without interrupting the current through the vein. The manner in which the artery and vein are united to one another here, was particularly described many years ago by Mr. Colles in his Surgical Anatomy; and it has been noticed in every work upon anatomy published since. In fact, if we lay bare the artery and vein by dissecting away the front of the sheath, we will find that (even under these favourable circumstances) it would be impossible to

apply the pad of an instrument here so as to compress the artery alone.

From a little below Poupart's ligament to the commencement of the middle third of the thigh, the femoral artery is unfavourably situated for compression; but in its middle third, and down to the point, at which the artery enters the opening between the tendons of the triceps and vastus internus muscles, it is favourably situated; and many patients bear pressure here better than in any other situation. The femoral vein in the middle third of the thigh lies so closely in contact with the artery that it must be compressed with it; and looking to the results of this method of treatment, pressure upon the vein hitherto has been attended by no ill consequences. Besides, I have already mentioned three instances where the opportunity had been afforded for making an examination of the limb after pressure had been employed; and in all three the vein and artery were found to be in a perfectly normal condition at the site of the pressure. Two other cases have likewise been recorded in the journals, where, after compression had been employed for a time, the operation was resorted to, yet no additional inconvenience was experienced in consequence in applying the ligature.

No matter upon what part of the limb the compression is made, or with what care the pressure is graduated, it becomes painful when constantly applied at the same part, and we are forced to relax it. This applies to every instrument which has been invented, and to every part upon which pressure can be made. We can, however, so manage the application as to maintain continued pressure for a considerable time, with comparatively little inconvenience to the patient, by a mode of using the compressing instruments to which I first called the attention of the profession—viz., by applying two or more instruments

upon separate parts of the limb, which are alternately tightened and relaxed. Since the advantages of this mode of applying compression were pointed out, the plan has been extensively adopted, and it has been found to answer the purpose intended in every respect. Indeed, in several instances, owing to the extreme susceptibility to pain in the patient, a cure could hardly have been accomplished if it had been necessary to maintain the pressure constantly at the one point.

In many of the cases in which compression has been employed, a bandage, rolled more or less tightly round the limb, has been used along with the compressing instruments. The advantages to be expected from this proceeding are not very apparent, while its disadvantages are sufficiently evident. I have already observed that the femoral vein, owing to its close connection with the artery, must be compressed together with it; it is obvious therefore that the venous blood must return in a great measure by the superficial veins; but if the current through these vessels is impeded or interrupted by a bandage or roller, congestion, œdema, and swelling of the limb can hardly fail to follow. There is one stage of aneurism, however, where a bandage may prove serviceable, (combined with a compress upon the aneurism,) as where the sac has become partially filled with fibrine, indicated by its feeling more solid to the touch, and by its not increasing in size on the removal of the compressing instruments. In such cases a bandage and compress on the tumour, by pressing the sac against the artery which supplies it, or against the orifice by which it communicates with the artery, may diminish materially the stream of blood which enters the sac, and thus lead to the rapid deposition of fibrine.

CIRCUMSTANCES CONNECTED WITH THE PATIENT HIMSELF.

ALTHOUGH the result of compression will be influenced in some measure by the kind of instrument used, or by the manner in which it is applied, the state of health of the patient, his irritability or susceptibility of pain, and his intelligence and anxiety to co-operate in maintaining the pressure, will have still greater influence upon the rapidity or slowness with which a cure is brought about. Many patients labouring under popliteal or femoral aneurism are perfectly healthy in other respects, and the disease is altogether local; in others, on the contrary, the health is more or less deranged, the constitution is bad, the disease may be complicated with anœmia or with anasarca, the heart's action may be increased, or organic disease of the aorta or of the valves of the heart may be present. In the former case no medical treatment almost will be required beyond regulating the bowels, and venesection occasionally to a moderate amount. In the latter, we must of course, at the same time, employ measures calculated to improve the general health; but to these I cannot more particularly allude here.

It occasionally happens that the patient is so irritable or so susceptible of pain that he soon becomes dissatisfied; he will relax the instruments if not constantly watched, or he may even refuse to continue the compression. Others think so lightly of the disease that we cannot prevail on them to keep up the pressure. These are the kind of cases which particularly try the surgeon's patience; in a form of treatment which may require to be continued for many weeks, it is difficult to maintain a constant surveillance; once the patient has learned to regulate the apparatus, the success of the treatment depends more upon himself than upon the surgeon; and unless he aids and assists, our efforts will be almost in vain. The patient therefore ought to be encouraged to persevere by every

means in our power; indeed, in general, he will soon discover that pressure upon the artery has the effect of relieving the pain from which he previously suffered in the affected limb; and after it has been employed for a time, he will find that he can maintain it for a longer period than he could at first.

It more frequently happens, however, that the patient is made dissatisfied with the treatment, owing to an undue degree of pressure being made at first, and an unnecessary degree of pain occasioned thereby. This mistake was almost unavoidably made by those who supposed it necessary to interrupt completely the circulation in the artery at the part; or who fancied that they could bring about the coagulation of the contents of the sac, and accelerate the cure by using very strong pressure. The consequences were that the surface became excoriated, the lymphatic glands in the groin became painful, the limb swollen, benumbed, or œdematous, and the cure of the disease, instead of being accelerated, was protracted.

It is not necessary to repeat what I have already said respecting the degree of pressure which should be used; it will be sufficient to observe, that the compression at first ought always to be light; after a time, when tolerance of the remedy becomes established, we may increase it to the degree we consider necessary; but it need never be so great as to interrupt completely the circulation in the artery at the point upon which it is applied. Although it is advisable, in the early stage of the treatment, to maintain a certain degree of pressure night and day, yet in most instances it will be found very difficult to do so; the patient cannot sleep unless the pressure is relaxed—if he does sleep, the pad becomes displaced, and the pressure is necessarily taken off the vessel. Indeed, if it were absolutely necessary to maintain permanent pressure in every instance until a cure was accomplished, we should seldom

succeed; and that it is not necessary to do so, the details of the cases already given afford sufficient evidence, the pressure having been frequently intermitted and resumed according to circumstances. Once fibrine begins to be deposited in the sac the deposition will go on, although pressure may be very carelessly applied; and after a certain amount of fibrine has been deposited in the sac the instruments may be removed, and a cure will be accomplished nevertheless. Indeed, it would appear from two cases previously quoted, that the patient may in some measure resume his ordinary habits and commence exercising the limb without interfering with the progress of the cure.

CIRCUMSTANCES CONNECTED WITH THE ANEURISMAL SAC, AND ITS POSITION WITH RESPECT TO THE ARTERY.

The situation of the aneurism, the length of time the disease has lasted, and the condition of the sac at the period when the treatment commenced, will have some influence upon the duration of the treatment. In all the cases previously detailed, the disease was seated in the popliteal or in the femoral artery; and as aneurism occurs more frequently in these vessels than in any other in the extremities, they will probably continue to afford the most frequent opportunities for employing this method. The femoral artery I have already shown to be favourably situated for the application of the compressing instruments; this applies also to the brachial artery. Compression has not as yet been employed in cases of axillary aneurism, although it is probably not beyond its reach; and I have no doubt that some of the instruments which have been invented for checking the circulation in the subclavian artery, in amputation at the shoulder-joint, may be modified so as to be used to compress this vessel in cases of axillary aneurism. An instrument adapted to

make pressure upon the subclavian artery, invented by Dahl, is described in the *Dict. de Medecine;* another, which is figured by Blasius, and referred to Mohrenheim, has some resemblance to Mr. L'Estrange's tourniquet previously described; and a third, of quite a different construction, is figured and described in Bourgery's "Medecine Operatoire."

The condition of the sac at the period when the treatment commenced, its size, and the rapid or slow progress of the disease, will have some influence upon the duration of the treatment. The more recent the aneurism and the smaller the size of the sac, the more likely is compression (as a general rule) to be quickly successful; because the orifice of communication between the sac and the artery is always small in such cases; a trifling amount of blood only therefore can enter the sac at each ventricular systole, and the deposition of fibrine will consequently proceed quickly. On the other hand, when the disease is of long standing, the orifice of communication between the sac and the artery becomes enlarged, its edges become rounded and smooth, and if the sac notwithstanding has remained stationary, the deposition of fibrine must go on but slowly, because the sac and the artery, under such circumstances, form, in some measure, one continued channel, and the current of blood through the sac will be but little impeded.

When an aneurism has lasted for some time, and when its progress has been slow, the sac usually contains more or less fibrine. On the other hand, when the sac has attained a large size within a short period, its contents are almost always fluid. In the former case, compression will be very likely to bring about a speedy cure by accelerating the deposition of fibrine; while in the latter, compression may have to be kept up for a long period before we can expect to make any considerable progress.

There is a point connected with the aneurismal sac

which probably has as much influence upon the rapid or slow progress of the cure by compression as any which has yet been mentioned. I allude to the position of the sac, and of the orifice leading to it, with respect to the artery. For instance, we know that in aneurism of the aorta, the sac sometimes springs from the anterior wall of the vessel, sometimes from its posterior wall; at others it arises from the internal, and at others from the external side of the artery. We also know that the symptoms of aneurism of this vessel in a great measure depend upon the part of the vessel from which the aneurism arises. Now, in popliteal aneurism, likewise, the opening by which the sac communicates with the artery may be seated upon its anterior, its posterior, its inner, or its outer side; and it is not difficult to understand how the position of the orifice and the direction which the sac takes, may render the deposition of fibrine rapid in one case and slow in another.

For instance, if the aneurism springs from the anterior surface of the popliteal artery (that is the surface facing the back of the knee-joint,) owing to the density of the structures here, the sac cannot enlarge much, and the entrance of blood into it must be impeded in some degree, owing to its position; hence if compression comes to be used in such a case, the cure will probably take place quickly. Now if, under such circumstances, a moderate amount of fibrine had been deposited in the sac previous to the patient coming under treatment, and we apply a bandage with a compress upon the tumour, we shall probably effect a rapid cure of the disease. Indeed it is probable that in some of the cases of what are termed spontaneous cures which have been recorded, the sac communicated with the artery at this point. When the aneurism has the situation just mentioned, any enlargement of the sac must be accompanied by severe pain, the patient consequently will be likely to make application early,

and the chances of a speedy cure of the disease by compression (for the reason already mentioned) become greater.

If the aneurism springs from the posterior wall of the popliteal artery, the sac may attain a larger size than in the preceding case, and its enlargement is often attended also by severe pain, extending down the leg to the ankle, owing to the stretching and compression of the large nerve which lies superficially to it here. In this case, compression upon the artery above is not likely to succeed as quickly as in the former; but if fibrine has been deposited in the sac, either spontaneously or as the result of compression, the application of a bandage and compress may effect an equally rapid cure, by pressing the sac against the artery from which the aneurism springs, or by diminishing the size of the orifice by which the sac and artery communicate. In fact, nature herself has sometimes effected the cure of aneurism in a nearly similar way; the sac as it enlarged, and became more or less filled with fibrine, owing to its position, came gradually to press upon the artery which supplied it, diminished the current of blood which entered it, and thus led to the rapid deposition of fibrine.

When the orifice by which the sac and artery communicate springs from the inner or outer side of the popliteal artery, the sac may attain a large size; and its enlargement is likely to be attended with less pain than in either of the preceding cases; and it appears to me that the treatment of the aneurism by compression will probably prove more tedious. In one case in which I had the opportunity of making an examination (owing to the patient's death from another disease,) where compression had been employed for a considerable time, the sac arose from the side of the popliteal artery. In these cases also, the application of a bandage and compress will be less likely.

for obvious reasons, to effect a cure than in either of those last mentioned.

ENLARGEMENT OF THE COLLATERAL VESSELS.

One of the objects for which compression in cases of popliteal aneurism was formerly used, was to bring about the enlargement of the collateral branches, by which it was expected that the risk of insufficient circulation in the limb when the ligature came to be applied would be diminished. If this could have been so readily accomplished by pressure upon the artery by an instrument from without; and if it were so easy a matter to cause the anastomosing vessels to enlarge and to carry on the circulation independent of the main artery of the limb, the necessity for the operation would have been done away with in all the cases in which it was used. The fact is, however, that the last thing which occurs, as the result of compression, is this enlargement of the collateral vessels; it seldom commences until the aneurism is on the point of being cured, and it is not completed until the sac and the artery from which it springs are filled by fibrine, and the circulation through the artery at the part is completely obliterated.

A very moderate share of physiological knowledge might have satisfied surgeons that such was the case. When compression is applied to the femoral artery in any part of its course, the amount of blood which passes down the limb must be diminished in proportion to the degree of pressure used, and the current through the vein will at the same time be completely interrupted; a smaller amount of blood than usual consequently circulates in the parts below the site of the pressure, but quite sufficient for the nourishment of the limb, and this state of things will continue until the necessity arises for the collateral vessels to become enlarged. This happens when the aneurismal sac has become filled with fibrine, and when the deposition has

gone on until the artery at the seat of the disease is also closed; the anastomosing vessels by which the circulation in the limb is to be maintained then rapidly increase in size, and no interruption to the circulation occurs. Indeed if nature had not made this provision for supplying blood to the parts below the aneurism, they would probably fall into a state of gangrene.

The results of compression upon the cardiac side of the aneurism, in cases of popliteal aneurism, have proved that the articular arteries about the knee do not become dilated so as to give a sensible pulsation to the finger until the aneurism is about being cured. Consequently one of the most favourable signs is a pulsation in one of these vessels, as it indicates that the process which nature sets up to maintain the circulation in the limb, when the artery is permanently obstructed at the seat of the aneurism, is about being accomplished; and when it is felt, we may hope for a speedy cessation of pulsation in the aneurism.

In several of the cases where compression had been employed, and in many in which what is termed a spontaneous cure occurred, (where a bandage with or without a compress upon the tumour had been merely applied,) it has been mentioned, that severe pain about the knee set in immediately previous to, and continued for a short time after, the cessation of pulsation in the aneurism; but no one hitherto has attempted to explain its cause. The pain which occurs under such circumstances it appears to me can be accounted for by the sudden increase in size of the anastomosing vessels which takes place at this period. For instance, we have seen that it sets in only when the pulsation in the aneurism is about to cease, at which period the anastomosing vessels enlarge; and it occurs in cases of spontaneous cure, as well as in those in which compression had been employed, and at the same period in both. Now, it has already been shown that the

cure of aneurism is accomplished in the same way in both these cases ; fibrine is gradually deposited in the aneurismal sac, until it and the artery from which it springs are completely obstructed, the blood is then necessarily impelled suddenly into the anastomosing branches, which must enlarge quickly in order to carry on the circulation in the limb ; and the pain probably arises, partly from the distension of the arterial tunics, and partly from the pressure to which the parts in the vicinity are submitted in consequence of the increase in size of these vessels.

CHAPTER XII.

Advantages of compression over the ligature—Compression effects the cure of aneurism by simpler and safer means than the ligature; this method of treatment more certain and more permanent than that by the operation—Cause of the return of pulsation in an aneurism subsequent to the operation—Objections to the treatment of aneurism by compression answered—Concluding remarks—Summary.

The history that has now been given of compression in aneurism proves that the objects with which it was employed formerly were unattainable, and that the principles upon which it was supposed to effect the cure of aneurism were erroneous; it can hardly surprise us therefore that this method should have fallen into disrepute.

Thus the majority of writers whose opinions have been quoted, supposed that compression could only prove effectual when it caused the obliteration of the artery at the seat of the pressure. By a few it was recommended (in the early stage of the disease) with the object of causing dilatation of the collateral vessels, and thus diminishing the risk of an insufficient supply of blood to the limb when the ligature came to be used; while those who did not consider it necessary to go the length of obliterating the artery, supposed it to be essential to interrupt the circulation in the vessel leading to the sac. On the other hand, the theory laid down in the preceding pages is based upon the mode in which nature cures internal aneurism, an essential agent in which is that a current of blood should pass through the sac; consequently, if the circulation in the vessel at the seat of the pressure were to

be interrupted, the very process by which the disease is cured would be impeded.

If it had been known that the cure of aneurism could be accomplished by simply diminishing the stream of blood which passes through the sac, and that a comparatively moderate degree of pressure only therefore was required, compression, instead of having been laid aside as a doubtful and uncertain method, would have been employed in every case in which it was admissible; and the practice long ere this would probably have reached a high degree of perfection. But I have already shown that surgeons were altogether ignorant of these facts, and that the mistaken views upon which they supposed it to effect the cure of aneurism led to a very erroneous practice; the cases of success therefore were few in comparison to the number of failures, and this method of treatment came eventually to be almost altogether discarded.

ADVANTAGES OF COMPRESSION OVER THE LIGATURE.

Notwithstanding that the amount of evidence which has been adduced in favour of the treatment of aneurism by compression is perhaps greater than has ever been brought forward within so short a period in support of a novel method of treatment, the cases in which it has been employed, forming, I may say, one unbroken chain of successful results: yet surgeons who have not seen it used, or who are accustomed to rely solely upon the ligature, may be slow in adopting what they may still look upon as an innovation. I shall therefore now endeavour to point out the advantages which this method of treating aneurism has over the ligature; and by instituting some kind of comparison between them, endeavour to do away with the objections which have or may be urged against compression.

It will, I believe, be admitted, that an aneurism once formed, has a constant tendency to increase in size; that, as it enlarges, the parietes of the sac become thinned, (more particularly if its progress has been rapid); and that these effects are due to the distending force of the blood exercised upon the interior of the sac. Now, if the latter can be taken off, the enlargement of the aneurismal sac would necessarily be put a stop to, before it had attained any considerable size; and its parietes would thus be prevented from becoming thinned. The first effect, then, of pressure upon the artery between the aneurism and the heart, is to diminish or take off the distending force of the blood, the tumour is immediately reduced in size, and becomes more or less flaccid; the distension from pressure to which the parts about it had been subjected being thus removed, the pain which many patients labouring under aneurism suffer from in the affected limb is relieved. When the aneurismal sac has thus been kept stationary for some time, although no other change should take place, its parietes will be strengthened rather than thinned; and the danger of rupture of the sac will be greatly diminished. Indeed many of the cases on record, where a circumscribed aneurism became diffused, necessitating amputation of the limb would probably have been saved by the timely application of compression to the artery between the aneurism and the heart. However, we know that the same measure which takes off the distending force of the blood from the interior of the sac, and which checks its further increase, will at the same time bring about other changes in the sac itself, which will not only prevent it from enlarging, but will, if persevered in, effect the cure of the disease.

That compression effects the cure of aneurism by more simple and safer means than the ligature,—that the treatment also is more certain,—and that the result is likely to

be more permanent than when the ligature is employed,—I shall now endeavour to prove.

That compression effects the cure of aneurism by more *simple* means than the ligature is evidenced by the facts—1st. That the mode in which the consolidation of the aneurism is brought about by compression is exactly the same as that in which a natural or spontaneous cure occurs; and 2ndly, because when a cure is effected by compression, the vessel is obliterated merely at the site of the aneurism; whereas when a ligature is applied in the usual situation at some distance from the tumour, the artery is obliterated both at the seat of the ligature and at the seat of the aneurism. Hence it is easy to understand why, when secondary hæmorrhage followed the operation, the application of a second ligature higher up so seldom succeeded; and we can hardly be surprised at gangrene attacking a limb, the main artery of which is obliterated at three different points.

That compression effects the cure of aneurism by *safer* means than the ligature is also evident, because its employment can be intermitted and resumed according to circumstances; and because no ill consequences have hitherto resulted from its use. On the other hand, the ligature of a large artery is always a precarious operation; when it is once applied, we must await its separation before the patient can be considered out of danger; and when it fails, which frequently happens, the case almost always terminates unfavourably, not from the increase of the disease, but from the operation performed for its relief. The artery in which aneurism (after the aorta) is most frequent, is the popliteal, and the ligature of the femoral artery for popliteal aneurism is more frequently unsuccessful than that of any other artery of equal size. Mr. Benjamin Phillips collected fifty-nine cases from various sources in which this vessel had been tied, in thirty-nine

of which it failed; and although (as Mr. Storks observes) the accuracy of these statistics may be denied, "yet every surgeon must allow that the deligation of a main artery for aneurism is an operation (notwithstanding the successful results some practitioners can boast of,) attended with great risk." On the other hand, I have given a list of twenty-seven cases of aneurism treated by compression of the femoral artery, in twenty-five of which it succeeded perfectly; of the other two, one died of erysipelas before the cure was completed; the other was operated on at the patient's urgent request, and recovered. A mode of treatment therefore which is exempt from all risk has many advantages on the score of humanity, which alone ought to constitute a strong argument in its favour.

The treatment of aneurism by compression is *more certain* than that by the ligature. We have already seen that the operation by ligature, however carefully performed, is a precarious one, and that it frequently fails; that secondary hæmorrhage from ulceration of the artery at the site of the ligature or phlebitis not unfrequently follow it; or that suppuration of the sac, hæmorrhage from it, or gangrene of the extremity, may ensue. Now, none of these unfortunate results have ever attended the treatment by compression, nor are any of them ever likely to follow it; because, in the first place, no injury whatever is inflicted upon either the artery or vein at the site of the pressure; and secondly, because the aneurismal sac, and the part of the artery from which it springs, are gradually filled up by fibrine, separated from the blood and deposited in the same way as when nature cures internal aneurism.

That a cure effected by compression is more likely to be *permanent* than when the ligature has been used, and that pulsation cannot return after the employment of compression, as sometimes has happened after the operation, might

be inferred from the manner in which the cessation of pulsation is brought about; and it is proved by the pathological facts already adduced. In one instance, where the patient had been under treatment by compression, but died previous to the cessation of pulsation in the aneurism, the sac was found to be in a great measure filled up by fibrine, deposited in concentric laminæ. In another, where the patient had laboured under popliteal and femoral aneurism in opposite limbs, and died some time after their cure by compression, the subsequent changes were shown; the contents of the sac had been absorbed, and the artery at the seat of the aneurism was converted into an impervious ligamentous band, proving that the cure had been permanent, and that it was physically impossible for an aneurism again to form at the part. A cure effected by the ligature can only be permanent when it causes the aneurismal sac to be filled up, and the artery to be obliterated at its seat, after the same manner as compression. If a loose coagulum of blood merely forms in the sac as the result of the ligature, there is danger either of the sac suppurating (for the reasons already mentioned), or a secondary aneurism may form at the part; neither of which have ever occurred after the treatment by compression.

When pulsation returned in an aneurism shortly after the operation, it was always a source of considerable anxiety to the surgeon; but if the principle upon which aneurism is cured had been understood, it need not have occasioned any; it merely indicated that a rather stronger current than usual passed through the sac, and that the process by which it was to be filled up was proceeding. When pulsation returned long after a supposed cure by operation; in other words, when a secondary aneurism formed at the part, it was naturally looked upon as a much more serious matter, indicating that the operation had failed; and

amputation of the limb was supposed to be the sole resource. But if again the theory upon which aneurism is cured had been understood, surgeons would have known that the formation of a secondary aneurism indicated that the sac had *not* been obliterated by the ligature, that nature had now set up the process by which this would be accomplished, and that a little assistance from art only was required to secure its permanency.

In addition, there are some other circumstances which tend to confirm what has been already said respecting the advantages of compression over the ligature. For instance, aneurism not unfrequently occurs in individuals in whom the coats of the artery leading to the sac are so much diseased, that the vessel, instead of taking on the adhesive inflammation after the application of the ligature, ulcerates, or the ligature cuts its way through, giving rise to secondary hæmorrhage. The disease is also not uncommon in individuals labouring under valvular or other disease of the heart, in subjects of intemperate habits, or broken down constitution, or in cases of the aneurismal diathesis, and where more than one aneurism exists at the same time; cases in which the ligature is contra-indicated, and where the surgeon with great reluctance would perform any operation; whereas pressure may be applied under these circumstances with nearly the same prospect of success as where the patient is perfectly healthy.

Again, aneurism occasionally occurs in individuals who have so much horror of a surgical operation that they cannot be induced to consent, although made aware of its absolute necessity and of the risk of delay. Such persons will gladly embrace any means by which they may be relieved from the necessity of undergoing an operation, and will cheerfully submit to any method of treatment which promises a chance of cure without it. Now, as the treatment of aneurism by compression involves no opera-

tion, patients labouring under this disease will probably make application at an earlier period, and for this reason will come under treatment at a more favourable period for effecting the cure than heretofore.

OBJECTIONS TO THE TREATMENT OF ANEURISM BY COMPRESSION ANSWERED.

It will now be necessary to notice some of the objections which have or may be urged against compression as a mode of treating aneurism.

In the first place, it has been urged as an objection to this method of treatment, that the arteries are few in number to which it is applicable. But what is really the fact? The artery, above all others, in which aneurism is most common (after the aorta) is the popliteal, and next in frequency are the femoral and brachial. Lisfranc has given a table of one hundred and seventy-nine cases of aneurism, exclusive of those of the aorta, collected from various sources, out of which number the popliteal artery was engaged in fifty-nine instances, while the carotid was engaged only seventeen times, the subclavian sixteen, and the external iliac but five times. But even this is probably much below the average, because few cases comparatively of popliteal aneurism have been recorded (owing to its frequency) unless there happened to have been some peculiarity in the case; whereas most of the operations upon the carotid, subclavian, and iliac arteries have been published. It must be recollected, also, that aneurism of the subclavian, carotid, or iliac arteries near their origin, which do not admit of the application of compression, do not admit either of the employment of the ligature. It surely, therefore, is no argument against this method of treating aneurism that, because the disease occurs in arteries beyond its reach, we should refuse to apply it to

vessels which admit of its application, or that the practice should be undervalued or condemned, because it cannot be used in every case.

It has been also urged as an objection to this method of treating aneurism that it is more tedious and more painful than that by the ligature. Undoubtedly the treatment of aneurism by compression is often tedious, but that it is occasionally less so than the ligature, several of the cases already noticed prove, the pulsation having ceased after it had been employed for a few days only; while in the cases in which it proved very tedious, some of the causes previously enumerated may have operated to retard the cure. As to compression being a more painful method than the operation of applying a ligature to a large artery, including the subsequent dressings, until the wound is healed, this might be a question if the chances of recovery were equal in both, or if compression was employed upon the old theory of endeavouring to obliterate the artery at the site of the pressure; but we have already seen that compression not unfrequently actually relieves the severe pain from which the patient suffers in the affected limb; and that when it has been carefully graduated at first, tolerance of the remedy becomes established, and the patient is then able to maintain it for a longer period and with less inconvenience than under other circumstances.

I am far, however, from denying that compression as employed now, is not painful; indeed some patients may find it so irksome as to refuse to continue it, or to call for the operation, the pain of which they suppose will be only momentary, and the danger of which they are ignorant. But there is a great difference in this respect in different individuals, sometimes owing to the difference of sensibility to pain in different subjects, sometimes to a greater degree of pressure being required in one case than another. For instance, a moderate amount of pressure will diminish

materially the current of blood in the artery in one subject, while a much stronger pressure will be required in another. This sometimes evidently depends upon the condition of the limb, more particularly the degree of development of the muscles, or the amount of superficial fat: a slighter degree of pressure will obviously be necessary when the limb is thin, and the muscles are poorly developed, than when this part is very muscular or much loaded with fat. Again, the condition of the heart and of the arterial system must likewise have some influence; thus, if the patient is plethoric, if the arteries are distended, or if the heart is hypertrophied, a greater degree of pressure necessarily will be required than under opposite circumstances. It is in such cases that venesection, by diminishing the tension of the arteries, and reducing the amount of blood, will generally be found serviceable; a less degree of pressure will be then required, less inconvenience will be experienced by the patient, and the pressure can be maintained for a longer period.

That there is a great difference in the sensibility to pain in different individuals has long been familiar to surgeons, and is frequently witnessed in operations; consequently some patients will be found who will maintain strong pressure for a long time without a murmur, while others will soon begin to complain, although the degree of pressure may be very moderate.

It is not, however, by contrasting the amount of pain experienced in these two opposite modes of treatment that we are to judge of their comparative merits. Admitting that, on the whole, the actual pain experienced is greater in the treatment by compression, when we contrast its perfect safety, its almost absolute certainty, with the risk and uncertainty which attend the operation, the advantages preponderate greatly in favour of compression. This appears to be the correct view to take of the question; and

I am convinced that no medical man who had witnessed the treatment of aneurism by compression, and who likewise had experience of the ligature, would think of employing *in his own person* any other method; but would consider himself fortunate, if he could be relieved of so formidable a disease, by submitting to a greater degree of pain even than compression upon the artery occasions.

It has been objected to this method of treating aneurism that the pulsation is more likely to return than when the ligature has been employed, owing to the artery not being obliterated at the point at which the pressure is made; consequently, that the patient cannot be considered safe from a relapse for a considerable time; while the period which has elapsed is too short to allow us to conclude that the cures which have been effected will be permanent. In reference to these objections, I shall merely observe, that the description, previously given, of the appearances found on a post-mortem examination of subjects who had been submitted to this method of treatment, proves that from the manner in which a cure is brought about, it must be permanent; and I may add, that in every case in which compression has been successfully used hitherto, the patient has remained well subsequently.

The foregoing are the principal objections which have been urged within the last few years against this method of treating aneurism; but they all admit of being readily answered. There are, however, one or two circumstances to which I may here allude, which probably have had as much influence in retarding its general employment, although they have not been ostensibly put forward as objections. Thus, it is difficult to do away with the prejudices of early education; surgeons have been taught, and have been in the habit of teaching for years, that the ligature is our sole resource in aneurism; besides they have so often witnessed the sudden and complete cessation

of pulsation in the tumour on the ligature being tightened, that they cannot bring themselves to believe the disease can be cured in any other way. Again, in the treatment of aneurism by compression, the *éclat* to be gained by the successful performance of a capital operation is wanting; while this method of treatment imposes a far greater amount of trouble on the surgeon than the ligature.

Having now enumerated the advantages which compression possesses over the ligature, and having replied to the objections which have or might be urged against this method, I wish it to be understood that I do not advocate it as being free from inconvenience, free from trouble, or free from pain; the process by which compression effects the cure of aneurism is necessarily gradual, and requires time to be accomplished, and the surgeon, if he expects to succeed, must make up his mind to exercise a degree of patience which may be seldom called for in other cases; on the part of the patient likewise a considerable share of forbearance will be necessary; the former must be prepared to witness his exertions thwarted, and his endeavours fruitless for a long time; while the latter must be content to submit to confinement to bed for perhaps many consecutive weeks, and to the additional inconvenience of wearing a compressing apparatus during the greater part of that time. Although this is taking rather an unfavourable view of this method of treatment, and although in many of the cases which have been detailed, the cure was accomplished within a comparatively short period, yet it would be misleading those who have not seen this method employed, or who are about to try it for the first time, to let them suppose that it has no drawbacks; and that it does not occasionally prove both tedious and painful. Compression, however, possesses this advantage over the ligature, that if persevered in, it cannot fail of effecting a cure; the cure may be impeded or protracted owing to a variety of

causes, but from the manner in which the aneurismal sac becomes filled up, it is evident that every day will contribute a little, and every hour the pressure is applied something will be gained; and no matter how long the treatment may last, if the patient and surgeon have sufficient perseverance, a permanent cure will ultimately be accomplished, while the employment of the pressure does not involve the slightest risk.

Having brought these remarks upon the treatment of aneurism by compression to a close, I shall conclude with a summary of some of the most material points bearing upon this method of treatment:—

1. The arteries to which compression is applicable being far more frequently the subject of aneurism than those to which it is inapplicable, compression is calculated to supersede the ligature in the great majority of cases.

2. The cure of aneurism by compression upon the artery between the aneurismal sac and the heart, according to the rules laid down here, is accomplished by the gradual deposition of the fibrine of the blood in the sac, until both the latter and the artery at the part are completely filled. The process is in fact exactly similar to that by which nature effects a spontaneous cure of aneurism.

3. Such an amount of pressure as would cause inflammation and adhesion between the opposite sides of the artery at the point compressed is never required.

4. The pressure should not be so great as to interrupt the circulation in the artery at the point compressed; an essential agent in the cure being that a current of blood should pass through the sac.

5. Compression by means of two or more instruments, one of which is alternately relaxed, is much more effectual than by any single instrument, and in many instances the pressure can be maintained by the patient himself.

6. The treatment of aneurism by compression does not

involve the slightest risk to the patient, and if persevered in cannot fail of effecting a cure.

7. A cure of aneurism effected by compression, according to the rules laid down here, must necessarily be permanent; and in every case in which a cure has been accomplished, the patients have remained well subsequently.

8. The femoral artery remains pervious after the cure at the point at which the pressure had been applied, and no morbid change of any kind is to be detected in either the artery or vein at the site of the compression.

9. When a cure is effected by compression, the vessel is obliterated only at the seat of the aneurism, and the artery at this part is eventually converted into an impervious ligamentous band.

10. Compression effects the cure of aneurism by more simple and safer means than the ligature, while it is applicable to a number of cases in which the operation is contra-indicated or inadmissible.

11. Compression is not necessarily a more tedious or more painful method of treating aneurism than the ligature, while it is much more certain, more likely to be permanent, and is free from all danger.

12. Compression, according to the rules laid down here, has little analogy with the old method which went by this name; and in fact has no greater resemblance to it than the Hunterian operation had to the operation for aneurism which it superseded.

THE END.

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